JAPANESE [JP,2002-232448,A]

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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CLAIMS

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[Claim(s)]
[Claim 1] In the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network, the subnet which holds two or more terminal units, and a backbone network and a subnet Said each network connection equipment supervises switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [ subnet ] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit are a network system which updates an ARP table based on the received ARP reply packet, and is characterized by the divided terminal unit communicating through a backbone network henceforth.
[Claim 2] Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware

address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, The network system according to claim 1 characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[Claim 3] In the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network, the subnet which holds two or more terminal units, and a backbone network and a subnet Said each network connection equipment supervises switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit are a network system which updates an ARP table based on the received ARP reply packet, and is characterized by the divided terminal unit communicating through a backbone network henceforth.

[Claim 4] Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network, Transmit to a subnet and said each terminal unit returns an ARP table based on the received ARP reply packet. Henceforth, the network system according to claim 3 characterized by communicating by specifying each other MAC Address directly between the terminal units on the same subnet.

[Claim 5] Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means The ARP reply packet generated by said 1st recovery packet generation means, The ARP reply packet generated by the 2nd recovery packet generation means is transmitted to a subnet. And said each terminal unit The network system according to claim 1 characterized by returning an ARP table based on the received ARP reply packet, and communicating by specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[Claim 6] Said contact information gathering means is the network system of any one publication of claim 1-5 characterized by having a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

[Claim 7] If it is in each network connection equipment which makes redundancy connection of a backbone network and the subnet which holds two or more terminal units Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact

information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [ subnet ] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, Network connection equipment characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ.

[Claim 8] Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, Network connection equipment according to claim 7 characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[Claim 9] If it is in each network connection equipment which makes redundancy connection of a backbone network and the subnet which holds two or more terminal units Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, Network connection equipment characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ.

[Claim 10] Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And network connection equipment according to claim 9 characterized by transmitting to a subnet the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network.
[Claim 11] Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means Network connection equipment according to claim 7 characterized by transmitting to a subnet the ARP reply packet generated by said 1st recovery packet generation means, and the ARP reply packet generated by the 2nd recovery packet generation means.
[Claim 12] Said contact information-gathering means is network connection equipment of any one publication of claim 7-11 characterized by to have a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the network system and network connection equipment between the terminals at the time of subnet fragmentation which can relieve a communication link especially about the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network and the subnet.
[0002]
[Description of the Prior Art] Hereafter, the conventional technique is explained. In IP (Internet Protocol) network, other networks and the divided subnet communicate with the exterior of the subnet concerned via a router with a router. However, since it becomes impossible to communicate with the exterior of a subnet when a router breaks down, generally performing redundancy-ization of a communication path using two or more routers is known.
[0003] As a system which performs redundancy-ization of a communication path using two or more routers, "the router network which has Subordinate's LAN relief function in a router failure" of a publication is in JP,11-261620,A, for example. Drawing 28 R> 8 is drawing showing the conventional structure of a system. drawing 28 -- setting -- 10 -- present -- business -- it is a router, 11 is a substitute router, 12 is other routers, 13 is an ATM network, and 14 is the subnet by which the router was redundancy-ized.
[0004] a technique given [ above-mentioned ] in an official report -- a subnet 14 -- one -- present -- business -- a router 10 -- present -- business -- substitute router 11 with an another router 10 is prepared. this time -- present -- business -- the network environment of a router 10 -- the substitute router 11 -- beforehand -- setting up -- the substitute router 11 -- a ping packet etc. -- present -- business -- a router 10 is supervised. and -- present -- business -- the case where a router 10 becomes a failure -- present -- business -- the MAC (Media Access Control) address which was being used with the router 10 -- the substitute router 11 -- succeeding -- the substitute router 11 -- present -- business -- it takes the place and operates to a router 10. if it says concretely -- present -- business -- the case where a router 10 becomes a failure -- the substitute router 11 -- present -- business -- the physical address currently used with the router 10 is succeeded, and junction of the communication link frame to the outside of a subnet is executed by proxy. Thereby, the connectability of a subnet 14 and other subnets is securable.
[0005] Moreover, as a system which performs redundancy-ization of a communication path using two or more routers, there is a network system which used VRRP (Virtual Router Redundancy Protocol, Internet Engineering Task Force:IETF RFC2338) in addition to the above.
[0006] Two or more routers constitute a virtual router, and VRRP shares a virtual MAC Address and a common IP address. present -- business -- a router transmits a VRRP message into a subnet periodically -- a virtual MAC Address and an IP address -- a standby router -- notifying -- present -- business -- **** of a router is made to know on the other hand -- a standby router -- fixed time amount -- present -- business -- there is no arrival of the VRRP message from a router -- having -- present -- business -- the failure of a router is detected and

substitute actuation is performed using a virtual MAC Address and an IP address.
[0007] Drawing 29 is drawing showing the configuration of the network system which used VRRP. In drawing 29 , 20 and 21 are routers, 23, 24, and 25 are switching hubs, 26 and 27 are terminal units, 28 is a subnet, and 29 is a backbone network.
[0008] Moreover, drawing 30 is drawing showing the outline of an ARP (Address Resolution Protocol) reply packet format in which it is used by VRRP. In drawing 30 , 30a is a destination MAC Address (MAC_DA), 30b is a transmitting agency MAC Address (MAC_SA), 30c is a source hardware address (solvent refined coal_MAC_ADDR), 30d is a source protocol address (solvent refined coal_IP_ADDR), 30e is a target hardware address (TAGT_MAC_ADDR), and 30f is a target protocol address (TAGT_IP_ADDR).
[0009] In terminal units 26 and 27, if the virtual MAC Address is set up as a default route, the communication link frame to the outside of a subnet will be transmitted to a virtual MAC Address. for example, the router 20 -- present -- business -- as a router, when the router 21 is operating as a standby router, a router 20 relays a communication link frame.
[0010] and -- present -- business -- failure of a router 20 transmits the ARP reply packet shown in drawing 30 to a subnet 28 in the standby router 21. That is, in the standby router 21, a virtual MAC Address is stored in transmitting agency MAC Address30b and source hardware address 30c, a share IP address is stored in source protocol address 30d, a broadcast address is stored in destination MAC Address 30a, and an ARP reply packet is transmitted to a subnet 28 in this condition.
[0011] Moreover, in each switching hub, the above-mentioned ARP reply packet is received and transmitted, it learns that the equipment of a virtual MAC Address is in the port of the direction of a router 21, and the MAC frame addressed to a virtual MAC Address is henceforth transmitted in the direction of a router 21. thereby -- present -- business -- when a router 20 breaks down, the connectability of a subnet 27 and other subnets can be secured.
[0012]
[Problem(s) to be Solved by the Invention] However, in the above and the system by which redundancy connection of two or more routers was made, when a subnet was divided, in spite of having connected physically each terminal unit linked to a separate segment via other networks, there was a problem of it becoming impossible to perform a mutual communication link.
[0013] For example, in drawing 29 , when a switching hub 24 breaks down, the ARP request packet from a terminal unit 26 to a terminal unit 27 cannot communicate by flowing becoming impossible. Moreover, although a terminal unit 26 sets the MAC Address of a terminal unit 27 as a destination MAC Address and transmits the packet to a terminal unit 27 about the case where the entry of a terminal unit 27 is stored in the ARP table of a terminal unit 26, the junction of the packet concerned will become impossible by failure of a switching hub 24, and a communication link will stop.
[0014] This invention is made in view of the above, and in the system by which redundancy connection of a subnet and other networks was made, when each terminal is divided by failure within a subnet, it aims at obtaining the network connection equipment which can continue the communication link between terminals.
[0015]
[Means for Solving the Problem] If it is in the network system concerning this invention in order to solve the technical problem mentioned above and to attain the purpose A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to the condition check section 101 of the gestalt of operation mentioned later) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information (equivalent to the contact information gathering section 102), A contact information-interchange means to

exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network (equivalent to the contact information-interchange section 103), A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments (equivalent to the subnet selection section 174), An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [ subnet ] based on said contact information, and had the ARP reply packet concerned chosen (equivalent to the packet generation section 173 and the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit (equivalent to a comparator 106), An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ (equivalent to the junction section 105), A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0016] If it is in the network system concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned (equivalent to the ARP packet receive section 518), When said ARP packet receiving means receives an ARP request packet The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information (equivalent to the Banking Inspection Department 519), A request transfer means to transmit said ARP request packet to a backbone network when said information is not included (equivalent to the request transfer section 520), A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet (equivalent to the reply transfer section 527), A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network (equivalent to the backbone packet receive section 521), A target protocol address is extracted from the ARP packet which received. A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single to hold or two or more subnets (equivalent to the subnet selection section 524), When said backbone packet receiving means receives an ARP request packet The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address (equivalent to the request packet transducer 525), A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen (equivalent to the request packet transmitting section 526), When said backbone packet receiving means receives an ARP reply packet The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted (equivalent to the retrieval section 519), A destination MAC Address and a target hardware address are rewritten to the MAC Address which it is as a result of retrieval. The reply packet conversion means which rewrites a source hardware address to a virtual MAC Address (equivalent to the reply packet transducer 522), It is characterized by having a reply packet transmitting means (equivalent to the reply packet transmitting section 523) to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0017] If it is in the network system concerning the next invention A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to condition check section 101a) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information (equivalent to transfer packet generation section 175a), The

packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network (equivalent to contact information-interchange section 103a), A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments (equivalent to subnet selection section 174a), An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen (equivalent to the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0018] If it is in the network system concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network, It is characterized by for said each terminal unit returning an ARP table based on the received ARP reply packet, and communicating by transmitting to a subnet and specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0019] If it is in the network system concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network The 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned (equivalent to 173d of packet generation sections), A preparation and said ARP reply packet generation / transmitting means The ARP reply packet generated by said 1st recovery packet generation means, The ARP reply packet generated by the 2nd recovery packet generation means is transmitted to a subnet. And said each terminal unit It is characterized by returning an ARP table based on the received ARP reply packet, and communicating by specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0020] In the network system concerning the next invention said contact information gathering means A request transmitting means to transmit an ICMP echo request message by the broadcast address (equivalent to the request transmitting section 441), A receiving means to receive an ICMP echo reply message as a response to said request (equivalent to a receive section 442), It is characterized by having a study means (equivalent to the study section 443) to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

[0021] If it is in the network connection equipment concerning the next invention Redundancy connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP

reply packet was generated [ subnet ] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0022] If it is in the network connection equipment concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, It is characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0023] If it is in the network connection equipment concerning the next invention Redundancy connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0024] If it is in the network connection equipment concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means It is characterized by transmitting to a subnet the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the ARP reply packet generated by said recovery packet generation means, and the backbone network.

[0025] If it is in the network connection equipment concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning

the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means It is characterized by transmitting to a subnet the ARP reply packet generated by said 1st recovery packet generation means, and the ARP reply packet generated by the 2nd recovery packet generation means.

[0026] In the network connection equipment concerning the next invention, it carries out that said contact information gathering means is equipped with a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message as the description.

[0027]

[Embodiment of the Invention] Below, the gestalt of operation of the network system concerning this invention and network connection equipment is explained at a detail based on a drawing. In addition, this invention is not limited by the gestalt of this operation.

[0028] Gestalt 1. drawing 1 of operation is drawing showing the configuration of the gestalt 1 of operation of the network connection equipment concerning this invention. In drawing 1 , 100 is network connection equipment, and 101 is the condition check section. 102 is the contact information gathering section and 103 is the contact information-interchange section. 104 is the packet transmitting section, 105 is the junction section, and 106 is a comparator. 107 is the Records Department which records contact information, and 108 is an ARP table. 173 is the packet generation section and 174 is the subnet selection section. 210 is a backbone network, 211 is a communication path to which between network connection equipment is connected, 230 is a subnet, 291 is input/output port of a subnet, and 293 is input/output port of a backbone network.

[0029] Moreover, drawing 2 is drawing showing an example of a network system which used the network connection equipment of the gestalt 1 of operation. In drawing 2 , 200 is the above-mentioned network connection equipment 100 and network connection equipment with the same configuration, 231,232,233,234 is a switching hub, 221,222,227 is a terminal unit, 223 is the ARP table of a terminal unit 221, 224 is the ARP table of a terminal unit 222, 281,282,283 is input/output port of a switching hub 231, 284,285 is input/output port of a switching hub 232, and 286,287,288,289 is input/output port of a switching hub 233.

[0030] Here, actuation of the above-mentioned network connection equipment is explained using drawing 1 and drawing 2 . In addition, with the gestalt of this operation, the network connection equipments 100 and 200 take a redundant configuration, and connect a backbone network 210 and a subnet 230. moreover, network connection equipment 100 -- as a standby router -- network connection equipment 200 -- present -- business -- it shall operate as a router, respectively

[0031] First, with network connection equipment 100, the condition check section 101 supervises switch-on with network connection equipment 200 via a subnet 230. It is good also as performing this monitor using ping, and good also as carrying out by the monitor of a VRRP message etc. Moreover, in the condition check section 101 of network connection equipment 100, the operating state of self-equipment is periodically transmitted to the condition check section 101 of network connection equipment 200 using the communication path 211 on a backbone network 210. or [ operating as a standby router with operating state here ] -- or -- present -- business -- the information which shows whether it is operating as a router is meant.

[0032] In addition, when a backbone network 210 is an ATM (Asynchronous Transfer Mode) network, VC (virtual channel) is used as an example of a communication path 211.

[0033] In this condition, when a terminal unit 221 and a terminal unit 222 perform data communication, in each terminal unit, each other IP address recognized beforehand and the

mutual MAC Address learned by ARP are registered into an ARP table. In addition, drawing 3 is drawing showing an example of the entry (an IP address, MAC Address) recorded on the ARP table of a terminal unit 221 (in (a), (b) expresses the time of a failure for always [ forward ]), 481a is an IP address (IP_222), 481b is a MAC Address (MAC_222), 482a is an IP address (IP_222), and 482b is a MAC Address (MAC_100). Moreover, drawing 4 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222 (in (a), (b) expresses the time of a failure for always [ forward ]), 486a is an IP address (IP_221), 486b is a MAC Address (MAC_221), 487a is an IP address (IP_221), and 487b is a MAC Address (MAC_200).
[0034] In a switching hub 231, the ARP packet transmitted from a terminal unit 221 is received in a port 282, and it learns that the terminal unit 221 is connected to the point of a port 282 based on a transmitting agency MAC Address. Moreover, the ARP packet transmitted from a terminal unit 222 is received in a port 283, and it learns that the terminal unit 222 is connected to the point of a port 283 based on a transmitting agency MAC Address. It learns that similarly a terminal unit 221 is connected to the point of a port 284, and entering 222 is connected to the point of a port 285 in a switching hub 232, and learns that a terminal unit 221 is connected to the point of a port 286, and the terminal unit 222 is further connected to the point of a port 287 in a switching hub 233.
[0035] After learning as mentioned above, in a switching hub 231, the MAC frame addressed to the MAC Address of a terminal unit 221 is outputted from a port 282, and the MAC frame addressed to the MAC Address of a terminal unit 222 is outputted from a port 283. Drawing 5 is drawing showing the transmitting MAC frame from a terminal unit 221 to a terminal unit 222. In drawing 5 , 300a is a MAC header unit, 300b is IP frame section, 301 is a destination MAC Address (MAC_222), 302 is a transmitting agency MAC Address (MAC_221), 303 is a destination IP address (IP_222), and 304 is a transmitting agency IP address (IP_221). Here, the IP address of a terminal unit 222 is set as destination IP address 303, the learned MAC Address is set as destination MAC Address 301, the IP address in the end of a local is set as transmitting agency IP address 304, the MAC Address in the end of a local is set as transmitting agency MAC Address 302, and the MAC frame is transmitted to a network after that.
[0036] And the above-mentioned MAC frame is notified to a terminal unit 222 via the ports 282 and 283 of a switching hub 231, the ports 284 and 285 of a switching hub 232, and the ports 286 and 287 of a switching hub 233 based on destination MAC Address 301.
[0037] On the other hand, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in the condition check section 101 of network connection equipment 100, failure generating is recognized by failure of ping, un-arriving [ of a VRRP message ], etc., and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 -- going -- network connection equipment 200 -- receiving -- self-equipment -- henceforth -- present -- business -- the purport which operates as a router is notified.
[0038] Drawing 6 is drawing showing the configuration of the contact information gathering section 102. In drawing 6 , 441 is the request transmitting section which transmits an ICMP echo request message by broadcasting, 442 is a receive section which receives an ICMP echo reply message, and 443 is the study section which learns the combination of an IP address and a MAC Address. Here, actuation of the contact information gathering section 102 in network connection equipment 100 is explained. In addition, it operates similarly about the contact information gathering section 102 in network connection equipment 200.
[0039] Moreover, drawing 7 is drawing showing an example of a MAC frame format which stores the ICMP echo request message used for contact information gathering. In drawing 7 , 451 is a MAC header unit, 452 is IP header unit, 453 is the ICMP message section, 454 is a destination MAC Address (MAC_Broadcast), 455 is a transmitting agency MAC Address (MAC_100), 456 is a destination IP address (IP_SubnetBroadcast), and 457 is a transmitting agency IP address (IP_100).
[0040] In the contact information gathering section 102 in network connection equipment 100, the ICMP echo request message generated because the request transmitting section 441 makes destination MAC Address 454 a broadcast address and makes destination IP address 456 the

broadcast address to a subnet 230 is transmitted to the port 291 of a subnet 230. This message is relayed by the switching hub 231, and is notified to a terminal unit 221.
[0041] In the terminal unit 221 which received the ICMP echo request message, an ICMP echo reply message is transmitted as a response. Drawing 8 is drawing showing an example of a MAC frame format which stores the ICMP echo reply message used for contact information gathering. In drawing 8 , 461 is a MAC header unit, 462 is IP header unit, 463 is the ICMP message section, 464 is a destination MAC Address (MAC_100), 465 is a transmitting agency MAC Address (MAC_221), 466 is a destination IP address (IP_100), and 467 is a transmitting agency IP address (IP_221). Here, the ICMP echo reply message generated by setting the IP address in the end of a local as transmitting agency IP address 467, and setting the MAC Address of self-equipment as transmitting agency MAC Address 465 as a response to an ICMP echo request message is transmitted. It is received by the receive section 442 of network connection equipment 100, and this reply message is notified to the study section 443.
[0042] In the study section 443, the received reply message is scrutinized, the combination of transmitting agency IP address 467 and transmitting agency MAC Address 465 is learned, and it stores in the Records Department 107 and the ARP table 108 by making the study result into contact information.
[0043] With the network connection equipment 100 which collected contact information by the contact information gathering section 102 as mentioned above, the contact information-interchange section 103 transmits the collected IP addresses to the communication path 211 on a backbone network 210. This contact information is notified to the contact information-interchange section 103 of network connection equipment 200, and is further transmitted to the subnet selection section 174.
[0044] In the subnet selection section 174 of network connection equipment 200, based on the received contact information, the subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 is chosen, and the contact information concerned is further notified to the packet generation section 173.
[0045] In the packet generation section 173 of network connection equipment 200, based on the received contact information, an ARP reply packet is generated and the packet concerned is transmitted to a subnet 230. Drawing 9 (a) is drawing showing an example of an ARP reply packet format. In drawing 9 (a), 470a is a destination MAC Address (MAC_Broadcast), 470b is a transmitting agency MAC Address (MAC_200), 470c is a source hardware address (MAC_200), 470d is a source protocol address (IP_200), 470e is a target hardware address (MAC_200), and 470f is a target protocol address (IP_221). The IP address here included in the received contact information is set as target protocol address 470f. The IP address which self-network connection equipment 200 is using in the port 292 is set as source protocol address 470d. The MAC Address which self-network connection equipment 200 is using in the port 292 is set as source hardware address 470c, target hardware address 470e, and transmitting agency MAC Address 470b. A broadcast address is set as destination MAC Address 470a, and the packet transmitting section 104 transmits the generated ARP reply packet to a subnet 230. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.
[0046] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 470f and target hardware address 470e which are contained in the packet concerned. Speaking concretely, updating like the entry which shows the entry shown in drawing 4 (a) to (b), for example. In addition, the above renewal actuation of an ARP table of a terminal unit 222 is general actuation of ARP specified to IETF (Internet Engineering Task Force) and RFC826. Moreover, after the completion of updating actuation, with a terminal unit 222, when transmitting an IP packet to a terminal unit 221, MAC Address 487b is set as a destination MAC Address, by the switching hub 233, a port 288 will be relayed and the received IP packet concerned will be transmitted to network connection equipment 200.
[0047] moreover, with network connection equipment 200, it has been sent from the condition check section 101 of network connection equipment 100 -- "-- present -- business -- it recognizes that the failure generated notice" of a purport which operates as a router in the subnet 230 in what the condition check section 101 receives. And in the same procedure as the

above-mentioned network connection equipment 100, the contact information gathering section 102 of network connection equipment 200 collects the IP addresses of terminal units 222 and 227 as contact information, and the contact information-interchange section 103 transmits the contact information concerned to network connection equipment 100.

[0048] And with the network connection equipment 100 which received contact information, with the same procedure as the above-mentioned network connection equipment 200, the ARP reply packet shown in the ARP reply packet shown in drawing 9 (b) and (c) is generated / transmitted using the contact information-interchange section 103, the subnet selection section 174, the packet generation section 173, and the packet transmitting section 104, and the ARP table 223 of a terminal unit 221 is updated. Speaking concretely, updating like the entry which shows the entry shown in drawing 3 R> 3 (a) to (b), for example. In addition, in drawing 9 (b), 471a is a destination MAC Address (MAC_Broadcast). 471b is a transmitting agency MAC Address (MAC_100), and 471c is a source hardware address (MAC_100). 471d is a source protocol address (IP_100), and 471e is a target hardware address (MAC_100). 471f is a target protocol address (IP_222), and it sets to drawing 9 (c). 472a is a destination MAC Address (MAC_Broadcast). 472b is a transmitting agency MAC Address (MAC_100), and 472c is a source hardware address (MAC_100). 472d is a source protocol address (IP_100), 472e is a target hardware address (MAC_100), and 472f is a target protocol address (IP_227).

[0049] However, a terminal unit 221 and a terminal unit 227 do not communicate, and even when the ARP reply packet which a terminal unit 221 shows to drawing 9 (c) when there is no entry equivalent to a terminal unit 227 in the ARP table 223 of a terminal unit 221 is received, updating and an addition of the ARP table 223 are not performed.

[0050] Since MAC Address 482b is set to the destination MAC Address of the MAC frame next when a terminal unit 221 transmits an IP packet to a terminal unit 222, in a switching hub 231, a port 281 is relayed and the received MAC frame is transmitted to network connection equipment 100.

[0051] With the network connection equipment 100 which received the MAC frame, a comparator 106 compares the IP address currently used in the port 291, the destination IP address in the MAC frame concerned, and the MAC Address currently used in the port 291 and the destination MAC Address in the MAC frame concerned, respectively. And when a MAC Address is equal and IP addresses differ, the junction section 105 relays the IP packet section in the MAC frame to network connection equipment 200.

[0052] With the network connection equipment 200 which received the IP packet, the IP packet concerned is set as the MAC frame, further, the MAC Address which corresponds by searching an ARP table based on a destination IP address is gained, the retrieval result is set as the destination MAC Address of the MAC frame, and the MAC frame generated here is relayed to a port 292. At this time, the MAC frame is notified to a terminal unit 222 via a switching hub 233. In addition, also when a terminal unit 222 transmits an IP packet to a terminal unit 221, network connection equipment 200 and network connection equipment 100 are relayed to an IP packet by the same procedure as the above, and it is notified to a terminal unit 221.

[0053] However, the IP address which each network connection equipment uses, and a MAC Address are good also as using the address which is different with each equipment, and good also as using the common address with protocols, such as VRRP. moreover, the case where the common address is used -- and -- present -- business -- while the network connection equipment which operates as a router is healthy, the network connection equipment which operates as a standby router does not communicate using the address concerned.

[0054] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to self is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing. Moreover, in the gestalt of this operation, an ICMP echo request message is

transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and contact information can be collected efficiently.
[0055] Gestalt 2. drawing 10 of operation is drawing showing the configuration of the gestalt 2 of operation of the network connection equipment concerning this invention. In drawing 10 , 100a is network connection equipment, 101a is the condition check section, 103a is the contact information-interchange section, 174a is the subnet selection section, and 175a is the transfer packet generation section. Moreover, drawing 11 is drawing showing an example of a network system which used the network connection equipment of the gestalt 2 of operation. In drawing 11 , 200a is network connection equipment with the same configuration as the above-mentioned network connection equipment 100a. In addition, about the same configuration as the gestalt 1 of the above-mentioned operation, the same sign is attached and the explanation is omitted.
[0056] Here, actuation of the above-mentioned network connection equipment is explained using drawing 10 and drawing 11 . In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 200a take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover, network connection equipment 100a -- as a standby router -- network connection equipment 200a -- present -- business -- it shall operate as a router, respectively Moreover, each network connection equipment shall share the virtual MAC Address (henceforth referred to as MAC_V), and the IP address (it is henceforth called IP_V).
[0057] First, in network connection equipment 100a, condition check section 101a supervises switch-on with network connection equipment 200a via a subnet 230. this monitor -- a VRRP message etc. -- using -- present -- business -- it carries out by receiving the periodical packet transmitted from a router. Moreover, in condition check section 101of network connection equipment 100a a, the operating state of self-equipment is periodically transmitted to condition check section 101of network connection equipment 200a a using the communication path 211 on a backbone network 210. or [ operating as a standby router with operating state here ] -- or -- present -- business -- the information which shows whether it is operating as a router is meant.

[0058] For example, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in condition check section 101of network connection equipment 100a a, failure generating is recognized by un-arriving [ of a VRRP message ], and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 -- going -- network connection equipment 200a -- receiving -- self-equipment -- henceforth -- present -- business -- the purport which operates as a router is notified.
[0059] In the contact information gathering section 102 (refer to drawing 6 ), with the same procedure as the case of the gestalt 1 of operation, the combination of a transmitting agency IP address and a transmitting agency MAC Address is learned, and it stores in the Records Department 107 and the ARP table 108 by making the result into contact information.
[0060] In network connection equipment 100a which collected contact information by the contact information gathering section 102 as mentioned above, transfer packet generation section 175a generates an ARP reply packet based on the contact information concerned. Drawing 12 (a) is drawing showing an example of an ARP reply packet format. In drawing 12 (a), 475a is a destination MAC Address (MAC_Broadcast), 475b is a transmitting agency MAC Address (MAC_V), 475c is a source hardware address (MAC_V), 475d is a source protocol address (IP_V), 475e is a target hardware address (MAC_V), and 475f is a target protocol address (IP_221). An ARP reply packet is generated by setting the IP address here included in the stored contact information as target protocol address 475f, setting MAC_V which is a virtual MAC Address, respectively as target hardware address 475e, source hardware address 475c, and transmitting agency MAC Address 475b, setting IP_V which is a share IP address as source protocol address 475d, and setting a broadcast address as destination MAC Address 475a.
[0061] And in contact information-interchange section 103a, contact information is transmitted

to the communication path 211 of a backbone network 210 in the form of the generated ARP reply packet. The contact information on this ARP reply packet format (it is only henceforth called an ARP reply packet) is notified to contact information-interchange section 103of network connection equipment 200a a, and is further transmitted to subnet selection section 174a.
[0062] The subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 based on the received ARP reply packet in subnet selection section 174of network connection equipment 200a a is chosen, and the ARP reply packet concerned is further transmitted to a subnet 230 in the packet transmitting section 104. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.
[0063] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 475f and target hardware address 475e which are contained in the packet concerned. Drawing 13 is drawing showing an example of the entry after updating (ARP table 224), 488a is an IP address (IP_221), and 488b is a MAC Address (MAC_V).
[0064] moreover, in network connection equipment 200a, it has been sent from condition check section 101of network connection equipment 100a a -- "-- present -- business -- it recognizes that the failure generated notice" of a purport which operates as a router in the subnet 230 in what condition check section 101a receives. In the same procedure as the above-mentioned network connection equipment 100a, and the contact information gathering section 102 of network connection equipment 200a The IP addresses of terminal units 222 and 227 are collected as contact information. Transfer packet generation section 175a generates the ARP reply packet shown in the ARP reply packet shown in drawing 12 (b) based on the contact information concerned, and (c). Contact information-interchange section 103a transmits contact information to network connection equipment 100a in the form of the ARP reply packet concerned. In addition, in drawing 12 (b), 476a is a destination MAC Address (MAC_Broadcast). 476b is a transmitting agency MAC Address (MAC_V), and 476c is a source hardware address (MAC_V). 476d is a source protocol address (IP_V), 476e is a target hardware address (MAC_V), 476f is a target protocol address (IP_222), and it sets to drawing 12 (c). 477a is a destination MAC Address (MAC_Broadcast). 477b is a transmitting agency MAC Address (MAC_V), and 477c is a source hardware address (MAC_V). 477d is a source protocol address (IP_V), 477e is a target hardware address (MAC_V), and 477f is a target protocol address (IP_227).
[0065] And in the same procedure as the above-mentioned network connection equipment 200a, using contact information-interchange section 103a, subnet selection section 174a, and the packet transmitting section 104, the ARP reply packet concerned is transmitted and the ARP table of a terminal unit 221 is updated in network connection equipment 100a which received the ARP reply packet. Drawing 14 is drawing showing an example of the entry after updating (ARP table 223), 483a is an IP address (IP_222), and 483b is a MAC Address (MAC_V).
[0066] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., the ARP table in each terminal unit is rewritten, it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to the divided terminal unit is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing.
[0067] Gestalt 3. drawing 15 of operation is drawing showing the configuration of the gestalt 3 of operation of the network connection equipment concerning this invention. In drawing 15 , 100b is network connection equipment, 501b is the ARP packet junction section, 107b is the Records Department which records contact information, 210b is a backbone network, 211b is a communication path to which between network connection equipment is connected, 230b is a subnet, 291b is input/output port linked to subnet 230b, and 293b is input/output port linked to a backbone network 210.
[0068] Moreover, drawing 16 is drawing showing the configuration of the above-mentioned ARP packet junction section 501b. In drawing 16 , 518 is an ARP packet receive section, 519 is the retrieval section, 520 is the request transfer section, 521 is a backbone packet receive section,

522 is a reply packet transducer, 523 is the reply packet transmitting section, 524 is the subnet selection section, 525 is a request packet transducer, 526 is the request packet transmitting section, and 527 is the reply transfer section.
[0069] Moreover, drawing 17 is drawing showing an example of a network system which used the network connection equipment of the gestalt 3 of operation. In drawing 17 , 200b is network connection equipment, and 240b and 250b are subnets. 504 is a subnet fragmentation part and 211b is a communication path to which between network connection equipment is connected. 531 is an ARP request packet transmitted from a terminal unit 221. 532 is an ARP request packet transmitted from network connection equipment 100b. 533 is an ARP request packet transmitted from network connection equipment 200b. 534 is an ARP reply packet transmitted from a terminal unit 222. 535 is an ARP reply packet transmitted from network connection equipment 200b. 536 by the ARP reply packet transmitted from network connection equipment 100b **, 291b is input/output port linked to subnet 230of network connection equipment 100b b, and 292b is input/output port linked to subnet 230of network connection equipment 200b b. In addition, about the same configuration as the gestalt 1 of the operation explained previously, the same sign is attached and the explanation is omitted.
[0070] Here, actuation of the above-mentioned network connection equipment is explained using drawing 15 , drawing 16 , and drawing 17 . In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 100b take a redundant configuration, and the network system of the gestalt of this operation connects backbone network 210b and subnet 230b. moreover, network connection equipment 100b -- as a standby router -- network connection equipment 200b -- present -- business -- as a router, it shall operate, respectively and the virtual MAC Address and the IP address shall be shared
[0071] First, in network connection equipment 100b, the condition check section 101 supervises switch-on with network connection equipment 200b via subnet 230b like the gestalt 1 of operation. And when subnet 230b is divided in the subnet fragmentation part 504 and divided like the A section of illustration, and the B section for example, in network connection equipment 100b, the condition check section 101 detects a failure and records the combination of an IP address and a MAC Address on Records Department 107b and the ARP table 108 as contact information in the same procedure as the gestalt 1 of the operation explained previously. then, network connection equipment 100b -- present -- business -- actuation as a router is performed.
[0072] For example, when the terminal unit 221 is not communicating with a terminal unit 222, the entry equivalent to a mutual terminal unit is not registered into the ARP table of each terminal unit, and in each terminal unit, even when the ARP reply packet transmitted from the packet transmitting section 104 is received, an entry is not added to an ARP table.
[0073] On the other hand, when a terminal unit 221 newly communicates with a terminal unit 222, in a terminal unit 221, the ARP request packet 531 is transmitted to a terminal unit 222. Drawing 18 is drawing showing an example of a format of an ARP request packet and an ARP reply packet, and especially drawing 18 (a) is drawing showing an example of the ARP request packet 531. In drawing 18 (a), 531a is a destination MAC Address, 531b is a transmitting agency MAC Address, 531c is a source hardware address, 531d is a source protocol address, 531e is a target hardware address, and 531f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 531a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address531b and source hardware address 531c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 531d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 531f.
[0074] In APR packet junction section 501of network connection equipment 100b which received ARP request packet 531 b, the ARP packet receive section 518 extracts target protocol address 531f in the ARP request packet 531 concerned. And if the IP address is not an IP address currently used by port 291b, it will search whether there is any entry to which the retrieval section 519 corresponds to target protocol address 531f at the entry recorded on Records Department 107b. In addition, since the terminal unit 222 has connected with the B section by

the side of network connection equipment 200b, a retrieval result here becomes having no applicable entry.

[0075] When there is no applicable entry, the ARP request packet 531 is transmitted to the request transfer section 520, and the ARP request packet 532 equivalent to the received ARP request packet 531 is transmitted to network connection equipment 200b in the request transfer section 520 in the retrieval section 519 through communication path 211b set up on backbone network 210b. Drawing 18 R> 8 (b) is drawing showing an example of the ARP request packet 532. In drawing 18 (b), 532a is a destination MAC Address, 532b is a transmitting agency MAC Address, 532c is a source hardware address, 532d is a source protocol address, 532e is a target hardware address, and 532f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 532a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address532b and source hardware address 532c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 532d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 532f.

[0076] In network connection equipment 200b which received the ARP request packet 532, the backbone packet receive section 521 notifies the ARP request packet 532 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 532f is extracted from the received ARP request packet 532, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 200b holds. And the ARP request packet 532 is notified to the request packet transducer 525.

[0077] In the request packet transducer 525 of network connection equipment 200b, transmitting agency MAC Address 532b of the ARP request packet 532 and source hardware address 532c are rewritten to a virtual MAC Address (MAC_V). And in the request packet transmitting section 526, the ARP request packet 533 after rewriting is transmitted from port 292b linked to subnet 230b. Drawing 18 (c) is drawing showing an example of the ARP request packet 533. In drawing 18 (c), 533a is a destination MAC Address, 533b is a transmitting agency MAC Address, 533c is a source hardware address, 533d is a source protocol address, 533e is a target hardware address, and 533f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 533a, a virtual MAC Address (MAC_V) is set as transmitting agency MAC Address533b and source hardware address 533c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 533d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 533f.

[0078] In the terminal unit 222 which received the ARP request packet 533, the IP address of the terminal unit 221 stored in source protocol address 533d and the virtual MAC Address stored in source hardware address 533c are learned, and the study result is registered into an ARP table. And the ARP reply packet 534 is transmitted as a response to the received packet. Drawing 18 (d) is drawing showing an example of the ARP reply packet 534. In drawing 18 (d), 534a is a destination MAC Address, 534b is a transmitting agency MAC Address, 534c is a source hardware address, 534d is a source protocol address, 534e is a target hardware address, and 534f is a target protocol address. Here, the virtual MA address (MAC_V) is set as destination MAC Address534a and target hardware address 534e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address534b and source hardware address 534c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 534d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 534f.

[0079] In APR packet junction section 501of network connection equipment 200b which received ARP reply packet 534 b, the ARP packet receive section 518 extracts target protocol address 534f in the ARP reply packet 534 concerned. And if the IP address is not an IP address currently used by port 292b, the ARP reply packet 534 will be transmitted to the reply transfer section 527. In the reply transfer section 527, the ARP reply packet 535 equivalent to the received ARP reply packet 534 is transmitted to network connection equipment 100b through communication path 211b set up on backbone network 210b. Drawing 18 (e) is drawing showing an example of the ARP reply packet 535. In drawing 18 (e), 535a is a destination MAC Address, 535b is a transmitting agency MAC Address, 535c is a source hardware address, 535d is a source protocol address, 535e is a target hardware address, and 535f is a target protocol address. Here, a virtual

MAC Address (MAC_V) is set as destination MAC Address535a and target hardware address 535e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address535b and source hardware address 535c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 535d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 535f.
[0080] In network connection equipment 100b which received the ARP reply packet 535, the backbone packet receive section 521 notifies the ARP reply packet 535 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 535f is extracted from the received ARP reply packet 535, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 100b holds. And the ARP reply packet 535 is notified to the reply packet transducer 522.
[0081] In the reply packet transducer 522 of network connection equipment 100b, target protocol address 535f of the ARP reply packet 535 is extracted. Then, the retrieval section 519 gains the MAC Address corresponding to the target protocol address 535f concerned, and rewrites destination MAC Address535a and target hardware address 535e based on the acquisition result. Moreover, in the reply packet transducer 522, transmitting agency MAC Address 535b and source hardware address 535c are rewritten to virtual MAC Address MAC_V currently used by port 291b. And in the reply packet transmitting section 523, the ARP reply packet 536 after rewriting is transmitted from port 291b linked to subnet 230b. Drawing 18 (f) is drawing showing an example of the ARP reply packet 536. In drawing 18 R> 8 (f), 536a is a destination MAC Address, 536b is a transmitting agency MAC Address, 536c is a source hardware address, 536d is a source protocol address, 536e is a target hardware address, and 536f is a target protocol address. Here, the MAC Address (MAC_221) of a terminal unit 221 is set as destination MAC Address536a and target hardware address 536e, a virtual MAC Address (MAC_V) is set as transmitting agency MAC Address536b and source hardware address 536c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 536d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 536f.
[0082] In the terminal unit 221 which received the ARP reply packet 536, the virtual MAC Address stored in source hardware address 536c is learned as a MAC Address corresponding to the IP address of a terminal unit 222, and it registers with an ARP table.
[0083] Henceforth, packet transmission to a terminal unit 222 from a terminal unit 221 is performed to a virtual MAC Address, and it is the same procedure as the gestalt 1 of operation, and hooks up to the network connection equipments 100b and 200b. Moreover, also with the packet transmission to a terminal unit 221 from a terminal unit 222, since the virtual MAC Address is registered into the ARP table, it is carried out to a virtual MAC Address. Thereby, a mutual communication link is attained.
[0084] Thus, in the gestalt of this operation, even when subnet 230b is divided, each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and it can newly communicate between the divided terminal units with which the entry is not registered from the first. Moreover, in the gestalt of this operation, address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and since an ARP table is updated, the communication link using a backbone network is attained, without adding special processing.
[0085] Gestalt 4. drawing 19 of operation is drawing showing the configuration of the gestalt 4 of operation of the network connection equipment concerning this invention. In drawing 19 , 100c is network connection equipment, 101c is the condition check section, 103c is the contact information-interchange section, 104c is the packet transmitting section, 107c is the Records Department, 174c is the subnet selection section, 175c is the transfer packet generation section, and 641c is the recovery packet generation section. in addition, about above-mentioned network connection equipment 100c, condition check section 101c, contact information-interchange section 103c, packet transmitting section 104c, Records Department 107c, subnet selection section 174c, and transfer packet generation section 175c It is premised on including

the same function as the condition check section in the gestalten 1 or 2 of the operation previously explained, respectively in addition to the characteristic function in the gestalt of this operation, the contact information-interchange section, the packet transmitting section, the Records Department, the subnet selection section, and the transfer packet generation section.
[0086] Moreover, drawing 20 is drawing showing an example of a network system which used the network connection equipment of the gestalt 4 of operation. In drawing 20 , 200c is network connection equipment. In addition, about the same configuration as the gestalten 1 or 2 of the operation explained previously, the same sign is attached and the explanation is omitted.
[0087] Here, actuation of the above-mentioned network connection equipment is explained using drawing 19 and drawing 20 . In addition, the gestalt of this operation explains only different actuation from the gestalten 1 or 2 of the operation explained previously. Moreover, the network connection equipments 100c and 200c take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover -- the gestalt of this operation -- network connection equipment 100c -- as a standby router -- network connection equipment 200c -- present -- business -- as a router, it operates, respectively and is further premised on the condition that the switching hub 232 broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107of network connection equipment 100c c, and the entry shown in drawing 24 was registered into Records Department 107of network connection equipment 200c c.
[0088] However, drawing 21 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221, in the entry at the time of failure generating shown in drawing 21 (a), 625a is an IP address, 626a is [ 625b is a MAC Address, ] an IP address in the entry of forward always shown in drawing 21 (b), and 626b is a MAC Address. Moreover, drawing 22 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222, in the entry at the time of failure generating shown in drawing 22 (a), 627a is an IP address, 628a is [ 627b is a MAC Address, ] an IP address in the entry of forward always shown in drawing 22 (b), and 628b is a MAC Address. Moreover, drawing 23 is the example of the entry recorded on Records Department 107of network connection equipment 100c c, in drawing 23 , 652a is an IP address and 652b is a MAC Address. Moreover, drawing 24 is the example of the entry recorded on Records Department 107of network connection equipment 200c c, in drawing 24 , 653a is an IP address and 653b is a MAC Address.
[0089] In this condition, if a switching hub 232 is recovered, in condition check section 101of network connection equipment 100c c, the flow of ping, the VRRP message reception from network connection equipment 200c, etc. will detect failure recovery of a subnet 230, and the purport to which self-equipment operates as a standby router to network connection equipment 200c via a communication path 211 will be notified.
[0090] In network connection equipment 200c which received the above-mentioned notice, condition check section 101c notifies that to recovery packet generation section 641c. In recovery packet generation section 641c, an ARP reply packet is generated with reference to Records Department 107c of self-equipment based on an entry. Drawing 25 is drawing showing an example of an ARP reply packet format. the ARP reply packet of network connection equipment 100c shown in drawing 25 (a) -- it is, 660a is a destination MAC Address, 660b is a transmitting agency MAC Address, 660c is a source hardware address, 660d is a source protocol address, 660e is a target hardware address, and 660f is a target protocol address. the ARP reply packet of network connection equipment 200c shown in drawing 25 (b) -- it is, 661a is a destination MAC Address, 661b is a transmitting agency MAC Address, 661c is a source hardware address, 661d is a source protocol address, 661e is a target hardware address, and 661f is a target protocol address.
[0091] Here, as shown in drawing 25 (b), IP address 653a (IP_222) is set as target protocol address 661f. MAC Address 653b (MAC_222) is set as target hardware address 661e. The IP address (IP_V) currently used for source protocol address 661d in the port 292 is set up. The

virtual MAC Address (MAC_V) currently used for source hardware address 661c and transmitting agency MAC Address 661b in the port 292 is set up, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 661a.
[0092] In packet transmitting section 104of network connection equipment 200c c, the ARP reply packet generated as mentioned above is transmitted from a port 292.
[0093] At this time, the entry of the ARP table shown in drawing 21 (a) is updated like drawing 21 (b) with the terminal unit 221 which received the ARP reply packet based on target hardware address 661e and target protocol address 661f contained in the packet concerned.
[0094] On the other hand, since network connection equipment 100c becomes a standby router, it cannot perform the communication link which used the virtual address on the subnet 230. Then, the information which network connection equipment 100c holds is transmitted to network connection equipment 200c, and an ARP reply packet is transmitted from network connection equipment 200c. Speaking concretely, by network connection equipment 100c, transfer packet generation section 175c's generating an ARP reply packet based on the entry currently recorded on Records Department 107c, if condition check section 101c detects failure recovery of a subnet 230. Here, as shown in drawing 25 (a), IP address 652a (IP_221) is set as target protocol address 660f, MAC Address 652b (MAC_221) is set as target hardware address 660e, a virtual IP address (IP_V) is set as source protocol address 660d, a virtual MAC Address (MAC_V) is set as source hardware address 660c and transmitting agency MAC Address 660b, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 660a.
[0095] In contact information-interchange section 103of network connection equipment 100c c, contact information is transmitted to network connection equipment 200c in the form of the ARP reply packet generated as mentioned above.
[0096] In network connection equipment 200c which received the above-mentioned contact information, i.e., an ARP reply packet, since subnet selection section 174c is reception from a backbone network 210 and a transmitting agency MAC Address is a virtual MAC Address of a port 292, it identifies that the destination is a subnet 230. And in packet transmitting section 104c, the packet concerned is transmitted from a port 292.
[0097] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.
[0098] Thus, in the gestalt of this operation, when the failure of a subnet 230 is recovered, each terminal unit can write as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [ forward ]) of a basis, and can continue the communication link between terminal units by direct assignment of a mutual MAC Address henceforth. Moreover, in the gestalt of this operation, it writes as the configuration which rewrites an ARP table by general actuation of ARP, and each terminal unit connected to the subnet 230 can choose a communication path, without adding special processing.
[0099] Gestalt 5. drawing 26 of operation is drawing showing the configuration of the gestalt 5 of operation of the network connection equipment concerning this invention. In drawing 26 , 100d is network connection equipment, 103d is the contact information-interchange section, 173d is the packet generation section, and 174d is the subnet selection section.
[0100] Moreover, drawing 27 is drawing showing an example of a network system which used the network connection equipment of the gestalt 5 of operation. In drawing 27 , 200d is network connection equipment. In addition, about the same configuration as the gestalten 1-4 of the operation explained previously, the same sign is attached and the explanation is omitted.
[0101] Here, actuation of the above-mentioned network connection equipment is explained using drawing 26 and drawing 27 . In addition, the gestalt of this operation explains only different actuation from the gestalten 1-4 of the operation explained previously. Moreover, the network system of the gestalt of this operation takes 100d of network connection equipment, and a configuration with redundant 200d, and connects a backbone network 210 and a subnet 230. moreover -- the gestalt of this operation -- 100d of network connection equipment -- as a standby router -- 200d of network connection equipment -- present -- business -- as a router, it operates, respectively and is further premised on the condition that the switching hub 232

broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107of network connection equipment 100c c, and the entry shown in drawing 24 R> 4 was registered into Records Department 107of network connection equipment 200c c.

[0102] In this condition, if a switching hub 232 is recovered, by 100d of network connection equipment, the ARP reply packet shown in drawing 25 will be generated like the gestalt 4 of the above-mentioned operation, and the ARP reply packet concerned will be transmitted from a port 292. And in a terminal unit 221, the entry of the ARP table shown in drawing 2121 (a) is updated like drawing 21 (b).

[0103] On the other hand, since 100d of network connection equipment serves as a standby router, it cannot perform the communication link which used the virtual address on the subnet 230. So, with 200d of network connection equipment, if condition check section 101c detects failure recovery of a subnet 230, 103d of contact information-interchange sections will generate contact information based on the entry currently recorded on Records Department 107c, and they will transmit the contact information concerned to 200d of network connection equipment. That is, with reference to the contents of the entry of drawing 23 , IP address 652a and MAC Address 652b are transmitted as contact information.

[0104] At 103d of contact information-interchange sections of 200d of network connection equipment which received contact information, the IP address included in the information concerned is transmitted to 174d of subnet selection sections, and in 174d of subnet selection sections, the subnet 230 in which the received IP address is included is chosen from the subnets which 100d of network connection equipment holds, and it notifies to 173d of packet generation sections.

[0105] In 173d of packet generation sections of 200d of network connection equipment, as shown in drawing 25 (a), an ARP reply packet is generated. And in packet transmitting section 104c, the received ARP reply packet is transmitted from a port 292.

[0106] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.

[0107] Thus, while writing as contact information as the configuration which sends only the combination of an IP address and a MAC Address and acquiring the same effectiveness as the gestalt 4 of the above-mentioned operation, as compared with the case where an ARP packet is transmitted, the traffic volume of a backbone network is sharply reducible in the gestalt of this operation, further. Moreover, in the gestalt of this operation, by the case where an ARP reply packet is generated based on the entry recorded on the Records Department of self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, mounting can be simplified.

[0108]

[Effect of the Invention] As mentioned above, even when each terminal unit in a subnet is divided by failure etc. according to this invention as explained, the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, when it is the same as that of the above, the terminal unit connected to the subnet writes the ARP reply packet generated with the network connection equipment connected to self as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0109] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that

address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and in order to update an ARP table, the effectiveness that the communication link using a backbone network is attained without adding special processing is done so.

[0110] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, the terminal unit connected to the subnet when it was the same as that of the above writes the ARP reply packet generated with the network connection equipment connected to the divided terminal unit as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0111] According to the next invention, when the failure of a subnet is recovered, each terminal unit writes as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [ forward ]) of a basis, and does so henceforth the effectiveness that the communication link between terminal units is continuable, by direct assignment of a mutual MAC Address. Moreover, each terminal unit connected to the subnet writes as the configuration which rewrites an ARP table by general actuation of ARP, and does so the effectiveness that a communication path can be chosen without adding special processing.

[0112] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.

[0113] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

[0114] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.

[0115] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so.

[0116] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.

[0117] According to the next invention, when the failure of a subnet is recovered, it writes as the configuration controlled to rewrite the entry of the ARP table on which each terminal unit was updated by the failure in the condition (always [ forward ]) of a basis, and the effectiveness that the communication link between terminal units is continuable is henceforth done so by

direct assignment of a mutual MAC Address.

[0118] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.

[0119] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

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## TECHNICAL FIELD

[Field of the Invention] This invention relates to the network system and network connection equipment between the terminals at the time of subnet fragmentation which can relieve a communication link especially about the network system equipped with two or more network connection equipments which make redundancy connection of a backbone network and the subnet.

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PRIOR ART

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[Description of the Prior Art] Hereafter, the conventional technique is explained. In IP (Internet Protocol) network, other networks and the divided subnet communicate with the exterior of the subnet concerned via a router with a router. However, since it becomes impossible to communicate with the exterior of a subnet when a router breaks down, generally performing redundancy-ization of a communication path using two or more routers is known.
[0003] As a system which performs redundancy-ization of a communication path using two or more routers, "the router network which has Subordinate's LAN relief function in a router failure" of a publication is in JP,11-261620,A, for example. Drawing 28 R> 8 is drawing showing the conventional structure of a system. drawing 28 -- setting -- 10 -- present -- business -- it is a router, 11 is a substitute router, 12 is other routers, 13 is an ATM network, and 14 is the subnet by which the router was redundancy-ized.
[0004] a technique given [ above-mentioned ] in an official report -- a subnet 14 -- one -- present -- business -- a router 10 -- present -- business -- substitute router 11 with an another router 10 is prepared. this time -- present -- business -- the network environment of a router 10 -- the substitute router 11 -- beforehand -- setting up -- the substitute router 11 -- a ping packet etc. -- present -- business -- a router 10 is supervised. and -- present -- business -- the case where a router 10 becomes a failure -- present -- business -- the MAC (Media Access Control) address which was being used with the router 10 -- the substitute router 11 -- succeeding -- the substitute router 11 -- present -- business -- it takes the place and operates to a router 10. if it says concretely -- present -- business -- the case where a router 10 becomes a failure -- the substitute router 11 -- present -- business -- the physical address currently used with the router 10 is succeeded, and junction of the communication link frame to the outside of a subnet is executed by proxy. Thereby, the connectability of a subnet 14 and other subnets is securable.
[0005] Moreover, as a system which performs redundancy-ization of a communication path using two or more routers, there is a network system which used VRRP (Virtual Router Redundancy Protocol, Internet Engineering Task Force:IETF RFC2338) in addition to the above.
[0006] Two or more routers constitute a virtual router, and VRRP shares a virtual MAC Address and a common IP address. present -- business -- a router transmits a VRRP message into a subnet periodically -- a virtual MAC Address and an IP address -- a standby router -- notifying -- present -- business -- **** of a router is made to know on the other hand -- a standby router -- fixed time amount -- present -- business -- there is no arrival of the VRRP message from a router -- having -- present -- business -- the failure of a router is detected and substitute actuation is performed using a virtual MAC Address and an IP address.
[0007] Drawing 29 is drawing showing the configuration of the network system which used VRRP. In drawing 29 , 20 and 21 are routers, 23, 24, and 25 are switching hubs, 26 and 27 are terminal units, 28 is a subnet, and 29 is a backbone network.
[0008] Moreover, drawing 30 is drawing showing the outline of an ARP (Address Resolution Protocol) reply packet format in which it is used by VRRP. In drawing 30 , 30a is a destination MAC Address (MAC_DA), 30b is a transmitting agency MAC Address (MAC_SA), 30c is a source hardware address (solvent refined coal_MAC_ADDR), 30d is a source protocol address (solvent

refined coal_IP_ADDR), 30e is a target hardware address (TAGT_MAC_ADDR), and 30f is a target protocol address (TAGT_IP_ADDR).

[0009] In terminal units 26 and 27, if the virtual MAC Address is set up as a default route, the communication link frame to the outside of a subnet will be transmitted to a virtual MAC Address. for example, the router 20 -- present -- business -- as a router, when the router 21 is operating as a standby router, a router 20 relays a communication link frame.

[0010] and -- present -- business -- failure of a router 20 transmits the ARP reply packet shown in drawing 30 to a subnet 28 in the standby router 21. That is, in the standby router 21, a virtual MAC Address is stored in transmitting agency MAC Address30b and source hardware address 30c, a share IP address is stored in source protocol address 30d, a broadcast address is stored in destination MAC Address 30a, and an ARP reply packet is transmitted to a subnet 28 in this condition.

[0011] Moreover, in each switching hub, the above-mentioned ARP reply packet is received and transmitted, it learns that the equipment of a virtual MAC Address is in the port of the direction of a router 21, and the MAC frame addressed to a virtual MAC Address is henceforth transmitted in the direction of a router 21. thereby -- present -- business -- when a router 20 breaks down, the connectability of a subnet 27 and other subnets can be secured.

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## EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, even when each terminal unit in a subnet is divided by failure etc. according to this invention as explained, the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, when it is the same as that of the above, the terminal unit connected to the subnet writes the ARP reply packet generated with the network connection equipment connected to self as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0109] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and in order to update an ARP table, the effectiveness that the communication link using a backbone network is attained without adding special processing is done so.

[0110] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so. Moreover, the terminal unit connected to the subnet when it was the same as that of the above writes the ARP reply packet generated with the network connection equipment connected to the divided terminal unit as the configuration which rewrites an ARP table in reception and general actuation of ARP, and does so the effectiveness that a communication path can be changed without adding special processing.

[0111] According to the next invention, when the failure of a subnet is recovered, each terminal unit writes as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [ forward ]) of a basis, and does so henceforth the effectiveness that the communication link between terminal units is continuable, by direct assignment of a mutual MAC Address. Moreover, each terminal unit connected to the subnet writes as the configuration which rewrites an ARP table by general actuation of ARP, and does so the effectiveness that a communication path can be chosen without adding special processing.

[0112] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from

other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.
[0113] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

[0114] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.
[0115] According to the next invention, even when a subnet is divided, the effectiveness that each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and can newly communicate between the divided terminal units with which the entry is not registered from the first is done so. Moreover, the effectiveness that address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address is done so.
[0116] According to the next invention, even when each terminal unit in a subnet is divided by failure etc., the ARP table in each terminal unit is rewritten, and the effectiveness of the ability to write as the configuration which communicates via a backbone network, and make the communication link between the distributed terminal units continuing is done so.
[0117] According to the next invention, when the failure of a subnet is recovered, it writes as the configuration controlled to rewrite the entry of the ARP table on which each terminal unit was updated by the failure in the condition (always [ forward ]) of a basis, and the effectiveness that the communication link between terminal units is continuable is henceforth done so by direct assignment of a mutual MAC Address.
[0118] According to the next invention, it writes as contact information as the configuration which sends only the combination of an IP address and a MAC Address, and the effectiveness that the traffic volume of a backbone network is sharply reducible further as compared with the case where an ARP packet is transmitted is done so. Moreover, by the case where an ARP reply packet is generated based on the contact information collected with self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, the effectiveness that mounting can be simplified is done so.
[0119] According to the next invention, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and the effectiveness that contact information is efficiently collectable is done so.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, in the above and the system by which redundancy connection of two or more routers was made, when a subnet was divided, in spite of having connected physically each terminal unit linked to a separate segment via other networks, there was a problem of it becoming impossible to perform a mutual communication link.
[0013] For example, in drawing 29 , when a switching hub 24 breaks down, the ARP request packet from a terminal unit 26 to a terminal unit 27 cannot communicate by flowing becoming impossible. Moreover, although a terminal unit 26 sets the MAC Address of a terminal unit 27 as a destination MAC Address and transmits the packet to a terminal unit 27 about the case where the entry of a terminal unit 27 is stored in the ARP table of a terminal unit 26, the junction of the packet concerned will become impossible by failure of a switching hub 24, and a communication link will stop.
[0014] This invention is made in view of the above, and in the system by which redundancy connection of a subnet and other networks was made, when each terminal is divided by failure within a subnet, it aims at obtaining the network connection equipment which can continue the communication link between terminals.

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MEANS

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[Means for Solving the Problem] If it is in the network system concerning this invention in order to solve the technical problem mentioned above and to attain the purpose A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to the condition check section 101 of the gestalt of operation mentioned later) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information (equivalent to the contact information gathering section 102), A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network (equivalent to the contact information-interchange section 103), A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments (equivalent to the subnet selection section 174), An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [ subnet ] based on said contact information, and had the ARP reply packet concerned chosen (equivalent to the packet generation section 173 and the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit (equivalent to a comparator 106), An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ (equivalent to the junction section 105), A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0016] If it is in the network system concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned (equivalent to the ARP packet receive section 518), When said ARP packet receiving means receives an ARP request packet The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information (equivalent to the Banking Inspection Department 519), A request transfer means to transmit said ARP request packet to a backbone network when said information is not included (equivalent to the request transfer section 520), A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet (equivalent to the reply transfer section 527), A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network (equivalent to the backbone packet receive section 521), A target protocol address is extracted from the ARP packet which received. A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single to hold or two or more subnets

(equivalent to the subnet selection section 524), When said backbone packet receiving means receives an ARP request packet The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address (equivalent to the request packet transducer 525), A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen (equivalent to the request packet transmitting section 526), When said backbone packet receiving means receives an ARP reply packet The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted (equivalent to the retrieval section 519), A destination MAC Address and a target hardware address are rewritten to the MAC Address which it is as a result of retrieval. The reply packet conversion means which rewrites a source hardware address to a virtual MAC Address (equivalent to the reply packet transducer 522), It is characterized by having a reply packet transmitting means (equivalent to the reply packet transmitting section 523) to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0017] If it is in the network system concerning the next invention A backbone network and the subnet which holds two or more terminal units, It has two or more network connection equipments which make redundancy connection of a backbone network and the subnet. Said each network connection equipment Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means (equivalent to condition check section 101a) to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information (equivalent to transfer packet generation section 175a), The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network (equivalent to contact information-interchange section 103a), A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments (equivalent to subnet selection section 174a), An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen (equivalent to the packet transmitting section 104), A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, An IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network when each IP addresses differ, A preparation and said each terminal unit update an ARP table based on the received ARP reply packet, and are henceforth characterized by communicating with the divided terminal unit through a backbone network.

[0018] If it is in the network system concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), A preparation and said ARP reply packet transmitting means The ARP reply packet generated by said recovery packet generation means, And the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the backbone network, It is characterized by for said each terminal unit returning an ARP table based on the received ARP reply packet, and communicating by transmitting to a subnet and specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0019] If it is in the network system concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered (equivalent to recovery packet generation section 641c), When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network The 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned (equivalent to 173d of packet generation sections), A

preparation and said ARP reply packet generation / transmitting means The ARP reply packet generated by said 1st recovery packet generation means, The ARP reply packet generated by the 2nd recovery packet generation means is transmitted to a subnet. And said each terminal unit It is characterized by returning an ARP table based on the received ARP reply packet, and communicating by specifying each other MAC Address directly between the terminal units on the same subnet henceforth.

[0020] In the network system concerning the next invention said contact information gathering means A request transmitting means to transmit an ICMP echo request message by the broadcast address (equivalent to the request transmitting section 441), A receiving means to receive an ICMP echo reply message as a response to said request (equivalent to a receive section 442), It is characterized by having a study means (equivalent to the study section 443) to learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message.

[0021] If it is in the network connection equipment concerning the next invention Redundancy connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A contact information-interchange means to exchange the collected contact information for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the equipment initial entry received from other network connection equipments, An ARP reply packet generation / transmitting means to transmit to the subnet which the ARP reply packet was generated [ subnet ] based on said contact information, and had the ARP reply packet concerned chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0022] If it is in the network connection equipment concerning the next invention Furthermore, an ARP packet receiving means to receive an ARP request packet or an ARP reply packet from a subnet, and to extract a target protocol address from the packet concerned, The 1st retrieval means which searches whether the information applicable to the target protocol address concerned was included in said collected contact information when said ARP packet receiving means received an ARP request packet, A request transfer means to transmit said ARP request packet to a backbone network when said information is not included, A reply transfer means to transmit the ARP reply packet concerned to a backbone network when said ARP packet receiving means receives an ARP reply packet, A backbone packet receiving means to receive an ARP request packet or an ARP reply packet from a backbone network, A subnet selection means to choose the subnet in which the target protocol address concerned is contained from the single which extracts and holds a target protocol address from the ARP packet which received, or two or more subnets, The request packet conversion means which rewrites the transmitting agency MAC Address and source hardware address of the packet concerned to a virtual MAC Address when said backbone packet receiving means receives an ARP request packet, A request packet transmitting means to transmit to the subnet which had the ARP request packet after rewriting chosen, The 2nd retrieval means which searches a MAC Address based on the target protocol address which said subnet selection means extracted when said backbone packet receiving means receives an ARP reply packet, The reply packet conversion means which rewrites a destination MAC Address and a target hardware address to the MAC Address which it is as a result of retrieval, and rewrites a source hardware address to a virtual MAC Address, It is characterized by having a reply packet transmitting means to transmit to the subnet which had the ARP reply packet after rewriting chosen.

[0023] If it is in the network connection equipment concerning the next invention Redundancy

connection of a backbone network and the subnet which holds two or more terminal units is made. For example Switch-on with other network connection equipments connected to the same subnet using the subnet and the backbone network is supervised. With a house keeping means to direct collection of contact information when the condition that each terminal unit in a subnet is divided has been recognized, and collection directions of contact information A contact information gathering means to collect the IP addresses and MAC Addresses of all terminal units on the same subnet as contact information, A packet generation means to generate an ARP reply packet based on the collected contact information, The packet operator stage which exchanges the generated ARP reply packet for other network connection equipments connected to the same subnet using a backbone network, A subnet selection means to choose a subnet based on the ARP reply packet received from other network connection equipments, An ARP reply packet transmitting means to transmit to the subnet which had said ARP reply packet chosen, A comparison means to compare a destination IP address with the IP address which self-equipment has when an IP packet is received from a terminal unit, When each IP addresses differ, it is characterized by having an IP packet transmitting means to transmit said IP packet to other network equipment through a backbone network.

[0024] If it is in the network connection equipment concerning the next invention Furthermore, a recovery packet generation means to generate the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, A preparation and said ARP reply packet transmitting means It is characterized by transmitting to a subnet the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned which received from the ARP reply packet generated by said recovery packet generation means, and the backbone network.

[0025] If it is in the network connection equipment concerning the next invention Furthermore, the 1st recovery packet generation means which generates the ARP reply packet for returning the ARP table of the terminal unit connected to the subnet concerned when a subnet is recovered, When the contact information for returning the ARP table of the terminal unit connected to the subnet concerned is received from a backbone network It has the 2nd recovery packet generation means which generates an ARP reply packet based on the contact information concerned. Said ARP reply packet generation / transmitting means It is characterized by transmitting to a subnet the ARP reply packet generated by said 1st recovery packet generation means, and the ARP reply packet generated by the 2nd recovery packet generation means.

[0026] In the network connection equipment concerning the next invention, it carries out that said contact information gathering means is equipped with a request transmitting means to transmit an ICMP echo request message by the broadcast address, a receiving means to receive an ICMP echo reply message as a response to said request, and a study means learn the combination of the IP address of the terminal unit in a subnet, and a MAC Address based on said ICMP echo reply message as the description.

[0027]

[Embodiment of the Invention] Below, the gestalt of operation of the network system concerning this invention and network connection equipment is explained at a detail based on a drawing. In addition, this invention is not limited by the gestalt of this operation.

[0028] Gestalt 1. drawing 1 of operation is drawing showing the configuration of the gestalt 1 of operation of the network connection equipment concerning this invention. In drawing 1 , 100 is network connection equipment, and 101 is the condition check section. 102 is the contact information gathering section and 103 is the contact information-interchange section. 104 is the packet transmitting section, 105 is the junction section, and 106 is a comparator. 107 is the Records Department which records contact information, and 108 is an ARP table. 173 is the packet generation section and 174 is the subnet selection section. 210 is a backbone network, 211 is a communication path to which between network connection equipment is connected, 230 is a subnet, 291 is input/output port of a subnet, and 293 is input/output port of a backbone network.

[0029] Moreover, drawing 2 is drawing showing an example of a network system which used the

network connection equipment of the gestalt 1 of operation. In drawing 2 , 200 is the above-mentioned network connection equipment 100 and network connection equipment with the same configuration, 231,232,233,234 is a switching hub, 221,222,227 is a terminal unit, 223 is the ARP table of a terminal unit 221, 224 is the ARP table of a terminal unit 222, 281,282,283 is input/output port of a switching hub 231, 284,285 is input/output port of a switching hub 232, and 286,287,288,289 is input/output port of a switching hub 233.
[0030] Here, actuation of the above-mentioned network connection equipment is explained using drawing 1 and drawing 2 . In addition, with the gestalt of this operation, the network connection equipments 100 and 200 take a redundant configuration, and connect a backbone network 210 and a subnet 230. moreover, network connection equipment 100 -- as a standby router -- network connection equipment 200 -- present -- business -- it shall operate as a router, respectively
[0031] First, with network connection equipment 100, the condition check section 101 supervises switch-on with network connection equipment 200 via a subnet 230. It is good also as performing this monitor using ping, and good also as carrying out by the monitor of a VRRP message etc. Moreover, in the condition check section 101 of network connection equipment 100, the operating state of self-equipment is periodically transmitted to the condition check section 101 of network connection equipment 200 using the communication path 211 on a backbone network 210. or [ operating as a standby router with operating state here ] -- or -- present -- business -- the information which shows whether it is operating as a router is meant.

[0032] In addition, when a backbone network 210 is an ATM (Asynchronous Transfer Mode) network, VC (virtual channel) is used as an example of a communication path 211.
[0033] In this condition, when a terminal unit 221 and a terminal unit 222 perform data communication, in each terminal unit, each other IP address recognized beforehand and the mutual MAC Address learned by ARP are registered into an ARP table. In addition, drawing 3 is drawing showing an example of the entry (an IP address, MAC Address) recorded on the ARP table of a terminal unit 221 (in (a), (b) expresses the time of a failure for always [ forward ]), 481a is an IP address (IP_222), 481b is a MAC Address (MAC_222), 482a is an IP address (IP_222), and 482b is a MAC Address (MAC_100). Moreover, drawing 4 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222 (in (a), (b) expresses the time of a failure for always [ forward ]), 486a is an IP address (IP_221), 486b is a MAC Address (MAC_221), 487a is an IP address (IP_221), and 487b is a MAC Address (MAC_200).
[0034] In a switching hub 231, the ARP packet transmitted from a terminal unit 221 is received in a port 282, and it learns that the terminal unit 221 is connected to the point of a port 282 based on a transmitting agency MAC Address. Moreover, the ARP packet transmitted from a terminal unit 222 is received in a port 283, and it learns that the terminal unit 222 is connected to the point of a port 283 based on a transmitting agency MAC Address. It learns that similarly a terminal unit 221 is connected to the point of a port 284, and entering 222 is connected to the point of a port 285 in a switching hub 232, and learns that a terminal unit 221 is connected to the point of a port 286, and the terminal unit 222 is further connected to the point of a port 287 in a switching hub 233.
[0035] After learning as mentioned above, in a switching hub 231, the MAC frame addressed to the MAC Address of a terminal unit 221 is outputted from a port 282, and the MAC frame addressed to the MAC Address of a terminal unit 222 is outputted from a port 283. Drawing 5 is drawing showing the transmitting MAC frame from a terminal unit 221 to a terminal unit 222. In drawing 5 , 300a is a MAC header unit, 300b is IP frame section, 301 is a destination MAC Address (MAC_222), 302 is a transmitting agency MAC Address (MAC_221), 303 is a destination IP address (IP_222), and 304 is a transmitting agency IP address (IP_221). Here, the IP address of a terminal unit 222 is set as destination IP address 303, the learned MAC Address is set as destination MAC Address 301, the IP address in the end of a local is set as transmitting agency IP address 304, the MAC Address in the end of a local is set as transmitting agency MAC Address 302, and the MAC frame is transmitted to a network after that.
[0036] And the above-mentioned MAC frame is notified to a terminal unit 222 via the ports 282

and 283 of a switching hub 231, the ports 284 and 285 of a switching hub 232, and the ports 286 and 287 of a switching hub 233 based on destination MAC Address 301.
[0037] On the other hand, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in the condition check section 101 of network connection equipment 100, failure generating is recognized by failure of ping, un-arriving [ of a VRRP message ], etc., and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 -- going -- network connection equipment 200 -- receiving -- self-equipment -- henceforth -- present -- business -- the purport which operates as a router is notified.
[0038] Drawing 6 is drawing showing the configuration of the contact information gathering section 102. In drawing 6 , 441 is the request transmitting section which transmits an ICMP echo request message by broadcasting, 442 is a receive section which receives an ICMP echo reply message, and 443 is the study section which learns the combination of an IP address and a MAC Address. Here, actuation of the contact information gathering section 102 in network connection equipment 100 is explained. In addition, it operates similarly about the contact information gathering section 102 in network connection equipment 200.
[0039] Moreover, drawing 7 is drawing showing an example of a MAC frame format which stores the ICMP echo request message used for contact information gathering. In drawing 7 , 451 is a MAC header unit, 452 is IP header unit, 453 is the ICMP message section, 454 is a destination MAC Address (MAC_Broadcast), 455 is a transmitting agency MAC Address (MAC_100), 456 is a destination IP address (IP_SubnetBroadcast), and 457 is a transmitting agency IP address (IP_100).
[0040] In the contact information gathering section 102 in network connection equipment 100, the ICMP echo request message generated because the request transmitting section 441 makes destination MAC Address 454 a broadcast address and makes destination IP address 456 the broadcast address to a subnet 230 is transmitted to the port 291 of a subnet 230. This message is relayed by the switching hub 231, and is notified to a terminal unit 221.
[0041] In the terminal unit 221 which received the ICMP echo request message, an ICMP echo reply message is transmitted as a response. Drawing 8 is drawing showing an example of a MAC frame format which stores the ICMP echo reply message used for contact information gathering. In drawing 8 , 461 is a MAC header unit, 462 is IP header unit, 463 is the ICMP message section, 464 is a destination MAC Address (MAC_100), 465 is a transmitting agency MAC Address (MAC_221), 466 is a destination IP address (IP_100), and 467 is a transmitting agency IP address (IP_221). Here, the ICMP echo reply message generated by setting the IP address in the end of a local as transmitting agency IP address 467, and setting the MAC Address of self-equipment as transmitting agency MAC Address 465 as a response to an ICMP echo request message is transmitted. It is received by the receive section 442 of network connection equipment 100, and this reply message is notified to the study section 443.
[0042] In the study section 443, the received reply message is scrutinized, the combination of transmitting agency IP address 467 and transmitting agency MAC Address 465 is learned, and it stores in the Records Department 107 and the ARP table 108 by making the study result into contact information.
[0043] With the network connection equipment 100 which collected contact information by the contact information gathering section 102 as mentioned above, the contact information-interchange section 103 transmits the collected IP addresses to the communication path 211 on a backbone network 210. This contact information is notified to the contact information-interchange section 103 of network connection equipment 200, and is further transmitted to the subnet selection section 174.
[0044] In the subnet selection section 174 of network connection equipment 200, based on the received contact information, the subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 is chosen, and the contact information concerned is further notified to the packet generation section 173.
[0045] In the packet generation section 173 of network connection equipment 200, based on the received contact information, an ARP reply packet is generated and the packet concerned is

transmitted to a subnet 230. Drawing 9 (a) is drawing showing an example of an ARP reply packet format. In drawing 9 (a), 470a is a destination MAC Address (MAC_Broadcast), 470b is a transmitting agency MAC Address (MAC_200), 470c is a source hardware address (MAC_200), 470d is a source protocol address (IP_200), 470e is a target hardware address (MAC_200), and 470f is a target protocol address (IP_221). The IP address here included in the received contact information is set as target protocol address 470f. The IP address which self-network connection equipment 200 is using in the port 292 is set as source protocol address 470d. The MAC Address which self-network connection equipment 200 is using in the port 292 is set as source hardware address 470c, target hardware address 470e, and transmitting agency MAC Address 470b. A broadcast address is set as destination MAC Address 470a, and the packet transmitting section 104 transmits the generated ARP reply packet to a subnet 230. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.

[0046] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 470f and target hardware address 470e which are contained in the packet concerned. Speaking concretely, updating like the entry which shows the entry shown in drawing 4 (a) to (b), for example. In addition, the above renewal actuation of an ARP table of a terminal unit 222 is general actuation of ARP specified to IETF (Internet Engineering Task Force) and RFC826. Moreover, after the completion of updating actuation, with a terminal unit 222, when transmitting an IP packet to a terminal unit 221, MAC Address 487b is set as a destination MAC Address, by the switching hub 233, a port 288 will be relayed and the received IP packet concerned will be transmitted to network connection equipment 200.

[0047] moreover, with network connection equipment 200, it has been sent from the condition check section 101 of network connection equipment 100 -- "-- present -- business -- it recognizes that the failure generated notice" of a purport which operates as a router in the subnet 230 in what the condition check section 101 receives. And in the same procedure as the above-mentioned network connection equipment 100, the contact information gathering section 102 of network connection equipment 200 collects the IP addresses of terminal units 222 and 227 as contact information, and the contact information-interchange section 103 transmits the contact information concerned to network connection equipment 100.

[0048] And with the network connection equipment 100 which received contact information, with the same procedure as the above-mentioned network connection equipment 200, the ARP reply packet shown in the ARP reply packet shown in drawing 9 (b) and (c) is generated / transmitted using the contact information-interchange section 103, the subnet selection section 174, the packet generation section 173, and the packet transmitting section 104, and the ARP table 223 of a terminal unit 221 is updated. Speaking concretely, updating like the entry which shows the entry shown in drawing 3 R> 3 (a) to (b), for example. In addition, in drawing 9 (b), 471a is a destination MAC Address (MAC_Broadcast). 471b is a transmitting agency MAC Address (MAC_100), and 471c is a source hardware address (MAC_100). 471d is a source protocol address (IP_100), and 471e is a target hardware address (MAC_100). 471f is a target protocol address (IP_222), and it sets to drawing 9 (c). 472a is a destination MAC Address (MAC_Broadcast). 472b is a transmitting agency MAC Address (MAC_100), and 472c is a source hardware address (MAC_100). 472d is a source protocol address (IP_100), 472e is a target hardware address (MAC_100), and 472f is a target protocol address (IP_227).

[0049] However, a terminal unit 221 and a terminal unit 227 do not communicate, and even when the ARP reply packet which a terminal unit 221 shows to drawing 9 (c) when there is no entry equivalent to a terminal unit 227 in the ARP table 223 of a terminal unit 221 is received, updating and an addition of the ARP table 223 are not performed.

[0050] Since MAC Address 482b is set to the destination MAC Address of the MAC frame next when a terminal unit 221 transmits an IP packet to a terminal unit 222, in a switching hub 231, a port 281 is relayed and the received MAC frame is transmitted to network connection equipment 100.

[0051] With the network connection equipment 100 which received the MAC frame, a comparator 106 compares the IP address currently used in the port 291, the destination IP address in the MAC frame concerned, and the MAC Address currently used in the port 291 and the destination

MAC Address in the MAC frame concerned, respectively. And when a MAC Address is equal and IP addresses differ, the junction section 105 relays the IP packet section in the MAC frame to network connection equipment 200.

[0052] With the network connection equipment 200 which received the IP packet, the IP packet concerned is set as the MAC frame, further, the MAC Address which corresponds by searching an ARP table based on a destination IP address is gained, the retrieval result is set as the destination MAC Address of the MAC frame, and the MAC frame generated here is relayed to a port 292. At this time, the MAC frame is notified to a terminal unit 222 via a switching hub 233. In addition, also when a terminal unit 222 transmits an IP packet to a terminal unit 221, network connection equipment 200 and network connection equipment 100 are relayed to an IP packet by the same procedure as the above, and it is notified to a terminal unit 221.

[0053] However, the IP address which each network connection equipment uses, and a MAC Address are good also as using the address which is different with each equipment, and good also as using the common address with protocols, such as VRRP. moreover, the case where the common address is used — and — present — business — while the network connection equipment which operates as a router is healthy, the network connection equipment which operates as a standby router does not communicate using the address concerned.

[0054] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to self is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing. Moreover, in the gestalt of this operation, an ICMP echo request message is transmitted by the broadcast address at the time of contact information gathering, it writes as the configuration which collects to coincidence the ICMP echo reply messages from each terminal unit connected to the subnet, and contact information can be collected efficiently.

[0055] Gestalt 2. drawing 10 of operation is drawing showing the configuration of the gestalt 2 of operation of the network connection equipment concerning this invention. In drawing 10 , 100a is network connection equipment, 101a is the condition check section, 103a is the contact information-interchange section, 174a is the subnet selection section, and 175a is the transfer packet generation section. Moreover, drawing 11 is drawing showing an example of a network system which used the network connection equipment of the gestalt 2 of operation. In drawing 11 , 200a is network connection equipment with the same configuration as the above-mentioned network connection equipment 100a. In addition, about the same configuration as the gestalt 1 of the above-mentioned operation, the same sign is attached and the explanation is omitted.

[0056] Here, actuation of the above-mentioned network connection equipment is explained using drawing 10 and drawing 11 . In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 200a take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover, network connection equipment 100a -- as a standby router -- network connection equipment 200a -- present -- business -- it shall operate as a router, respectively Moreover, each network connection equipment shall share the virtual MAC Address (henceforth referred to as MAC_V), and the IP address (it is henceforth called IP_V).

[0057] First, in network connection equipment 100a, condition check section 101a supervises switch-on with network connection equipment 200a via a subnet 230. this monitor -- a VRRP message etc. -- using -- present -- business -- it carries out by receiving the periodical packet transmitted from a router. Moreover, in condition check section 101of network connection equipment 100a a, the operating state of self-equipment is periodically transmitted to condition check section 101of network connection equipment 200a a using the communication path 211 on a backbone network 210. or [ operating as a standby router with operating state here ] -- or -- present -- business -- the information which shows whether it is operating as a router is meant.

[0058] For example, when a switching hub 232 breaks down and it becomes impossible to perform junction actuation, in condition check section 101of network connection equipment 100a a, failure generating is recognized by un-arriving [ of a VRRP message ], and collection of contact information is directed to the contact information gathering section 102. and the communication path 211 -- going -- network connection equipment 200a -- receiving -- self-equipment -- henceforth -- present -- business -- the purport which operates as a router is notified.
[0059] In the contact information gathering section 102 (refer to drawing 6 ), with the same procedure as the case of the gestalt 1 of operation, the combination of a transmitting agency IP address and a transmitting agency MAC Address is learned, and it stores in the Records Department 107 and the ARP table 108 by making the result into contact information.
[0060] In network connection equipment 100a which collected contact information by the contact information gathering section 102 as mentioned above, transfer packet generation section 175a generates an ARP reply packet based on the contact information concerned. Drawing 12 (a) is drawing showing an example of an ARP reply packet format. In drawing 12 (a), 475a is a destination MAC Address (MAC_Broadcast), 475b is a transmitting agency MAC Address (MAC_V), 475c is a source hardware address (MAC_V), 475d is a source protocol address (IP_V), 475e is a target hardware address (MAC_V), and 475f is a target protocol address (IP_221). An ARP reply packet is generated by setting the IP address here included in the stored contact information as target protocol address 475f, setting MAC_V which is a virtual MAC Address, respectively as target hardware address 475e, source hardware address 475c, and transmitting agency MAC Address 475b, setting IP_V which is a share IP address as source protocol address 475d, and setting a broadcast address as destination MAC Address 475a.
[0061] And in contact information-interchange section 103a, contact information is transmitted to the communication path 211 of a backbone network 210 in the form of the generated ARP reply packet. The contact information on this ARP reply packet format (it is only henceforth called an ARP reply packet) is notified to contact information-interchange section 103of network connection equipment 200a a, and is further transmitted to subnet selection section 174a.
[0062] The subnet 230 which holds the communication terminal 222 which may communicate with a terminal unit 221 based on the received ARP reply packet in subnet selection section 174of network connection equipment 200a a is chosen, and the ARP reply packet concerned is further transmitted to a subnet 230 in the packet transmitting section 104. At this time, an ARP reply packet is notified to a terminal unit 222 via a switching hub 233.
[0063] In the terminal unit 222 which received the ARP reply packet, the ARP table 224 is updated based on target protocol address 475f and target hardware address 475e which are contained in the packet concerned. Drawing 13 is drawing showing an example of the entry after updating (ARP table 224), 488a is an IP address (IP_221), and 488b is a MAC Address (MAC_V).
[0064] moreover, in network connection equipment 200a, it has been sent from condition check section 101of network connection equipment 100a a -- "-- present -- business -- it recognizes that the failure generated notice" of a purport which operates as a router in the subnet 230 in what condition check section 101a receives. In the same procedure as the above-mentioned network connection equipment 100a, and the contact information gathering section 102 of network connection equipment 200a The IP addresses of terminal units 222 and 227 are collected as contact information. Transfer packet generation section 175a generates the ARP reply packet shown in the ARP reply packet shown in drawing 12 (b) based on the contact information concerned, and (c). Contact information-interchange section 103a transmits contact information to network connection equipment 100a in the form of the ARP reply packet concerned. In addition, in drawing 12 (b), 476a is a destination MAC Address (MAC_Broadcast). 476b is a transmitting agency MAC Address (MAC_V), and 476c is a source hardware address (MAC_V). 476d is a source protocol address (IP_V), 476e is a target hardware address (MAC_V), 476f is a target protocol address (IP_222), and it sets to drawing 12 (c). 477a is a destination MAC Address (MAC_Broadcast). 477b is a transmitting agency MAC Address (MAC_V), and 477c is a source hardware address (MAC_V). 477d is a source protocol address (IP_V), 477e is a target

hardware address (MAC_V), and 477f is a target protocol address (IP_227).
[0065] And in the same procedure as the above-mentioned network connection equipment 200a, using contact information-interchange section 103a, subnet selection section 174a, and the packet transmitting section 104, the ARP reply packet concerned is transmitted and the ARP table of a terminal unit 221 is updated in network connection equipment 100a which received the ARP reply packet. Drawing 14 is drawing showing an example of the entry after updating (ARP table 223), 483a is an IP address (IP_222), and 483b is a MAC Address (MAC_V).
[0066] Thus, even when each terminal unit in a subnet 230 is divided by failure etc., the ARP table in each terminal unit is rewritten, it can write as the configuration which communicates via a backbone network 210, and the communication link between the distributed terminal units can be made to continue in the gestalt of this operation. Moreover, when it is the same as that of the above, the ARP reply packet which the terminal unit connected to the subnet generated with the network connection equipment connected to the divided terminal unit is written as the configuration which rewrites an ARP table in reception and general actuation of ARP, and a communication path can be changed, without adding special processing.
[0067] Gestalt 3. drawing 15 of operation is drawing showing the configuration of the gestalt 3 of operation of the network connection equipment concerning this invention. In drawing 15 , 100b is network connection equipment, 501b is the ARP packet junction section, 107b is the Records Department which records contact information, 210b is a backbone network, 211b is a communication path to which between network connection equipment is connected, 230b is a subnet, 291b is input/output port linked to subnet 230b, and 293b is input/output port linked to a backbone network 210.
[0068] Moreover, drawing 16 is drawing showing the configuration of the above-mentioned ARP packet junction section 501b. In drawing 16 , 518 is an ARP packet receive section, 519 is the retrieval section, 520 is the request transfer section, 521 is a backbone packet receive section, 522 is a reply packet transducer, 523 is the reply packet transmitting section, 524 is the subnet selection section, 525 is a request packet transducer, 526 is the request packet transmitting section, and 527 is the reply transfer section.
[0069] Moreover, drawing 17 is drawing showing an example of a network system which used the network connection equipment of the gestalt 3 of operation. In drawing 17 , 200b is network connection equipment, and 240b and 250b are subnets. 504 is a subnet fragmentation part and 211b is a communication path to which between network connection equipment is connected. 531 is an ARP request packet transmitted from a terminal unit 221. 532 is an ARP request packet transmitted from network connection equipment 100b. 533 is an ARP request packet transmitted from network connection equipment 200b. 534 is an ARP reply packet transmitted from a terminal unit 222. 535 is an ARP reply packet transmitted from network connection equipment 200b. 536 by the ARP reply packet transmitted from network connection equipment 100b **, 291b is input/output port linked to subnet 230of network connection equipment 100b b, and 292b is input/output port linked to subnet 230of network connection equipment 200b b. In addition, about the same configuration as the gestalt 1 of the operation explained previously, the same sign is attached and the explanation is omitted.
[0070] Here, actuation of the above-mentioned network connection equipment is explained using drawing 15 , drawing 16 , and drawing 17 . In addition, the gestalt of this operation explains only different actuation from the gestalt 1 of the above-mentioned operation. Moreover, the network connection equipments 100a and 100b take a redundant configuration, and the network system of the gestalt of this operation connects backbone network 210b and subnet 230b. moreover, network connection equipment 100b — as a standby router -- network connection equipment 200b -- present -- business -- as a router, it shall operate, respectively and the virtual MAC Address and the IP address shall be shared
[0071] First, in network connection equipment 100b, the condition check section 101 supervises switch-on with network connection equipment 200b via subnet 230b like the gestalt 1 of operation. And when subnet 230b is divided in the subnet fragmentation part 504 and divided like the A section of illustration, and the B section for example, in network connection equipment 100b, the condition check section 101 detects a failure and records the combination of an IP

address and a MAC Address on Records Department 107b and the ARP table 108 as contact information in the same procedure as the gestalt 1 of the operation explained previously. then, network connection equipment 100b -- present -- business -- actuation as a router is performed.
[0072] For example, when the terminal unit 221 is not communicating with a terminal unit 222, the entry equivalent to a mutual terminal unit is not registered into the ARP table of each terminal unit, and in each terminal unit, even when the ARP reply packet transmitted from the packet transmitting section 104 is received, an entry is not added to an ARP table.
[0073] On the other hand, when a terminal unit 221 newly communicates with a terminal unit 222, in a terminal unit 221, the ARP request packet 531 is transmitted to a terminal unit 222. Drawing 18 is drawing showing an example of a format of an ARP request packet and an ARP reply packet, and especially drawing 18 (a) is drawing showing an example of the ARP request packet 531. In drawing 18 (a), 531a is a destination MAC Address, 531b is a transmitting agency MAC Address, 531c is a source hardware address, 531d is a source protocol address, 531e is a target hardware address, and 531f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 531a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address531b and source hardware address 531c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 531d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 531f.
[0074] In APR packet junction section 501of network connection equipment 100b which received ARP request packet 531 b, the ARP packet receive section 518 extracts target protocol address 531f in the ARP request packet 531 concerned. And if the IP address is not an IP address currently used by port 291b, it will search whether there is any entry to which the retrieval section 519 corresponds to target protocol address 531f at the entry recorded on Records Department 107b. In addition, since the terminal unit 222 has connected with the B section by the side of network connection equipment 200b, a retrieval result here becomes having no applicable entry.
[0075] When there is no applicable entry, the ARP request packet 531 is transmitted to the request transfer section 520, and the ARP request packet 532 equivalent to the received ARP request packet 531 is transmitted to network connection equipment 200b in the request transfer section 520 in the retrieval section 519 through communication path 211b set up on backbone network 210b. Drawing 18 R> 8 (b) is drawing showing an example of the ARP request packet 532. In drawing 18 (b), 532a is a destination MAC Address, 532b is a transmitting agency MAC Address, 532c is a source hardware address, 532d is a source protocol address, 532e is a target hardware address, and 532f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 532a, the MAC Address (MAC_221) of a terminal unit 221 is set as transmitting agency MAC Address532b and source hardware address 532c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 532d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 532f.
[0076] In network connection equipment 200b which received the ARP request packet 532, the backbone packet receive section 521 notifies the ARP request packet 532 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 532f is extracted from the received ARP request packet 532, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 200b holds. And the ARP request packet 532 is notified to the request packet transducer 525.
[0077] In the request packet transducer 525 of network connection equipment 200b, transmitting agency MAC Address 532b of the ARP request packet 532 and source hardware address 532c are rewritten to a virtual MAC Address (MAC_V). And in the request packet transmitting section 526, the ARP request packet 533 after rewriting is transmitted from port 292b linked to subnet 230b. Drawing 18 (c) is drawing showing an example of the ARP request packet 533. In drawing 18 (c), 533a is a destination MAC Address, 533b is a transmitting agency MAC Address, 533c is a source hardware address, 533d is a source protocol address, 533e is a target hardware address, and 533f is a target protocol address. Here, a broadcast address (MAC_BC) is set as destination MAC Address 533a, a virtual MAC Address (MAC_V) is set as transmitting agency

MAC Address533b and source hardware address 533c, the IP address (IP_221) of a terminal unit 221 is set as source protocol address 533d, and the IP address (IP_222) of a terminal unit 222 is set as target protocol address 533f.
[0078] In the terminal unit 222 which received the ARP request packet 533, the IP address of the terminal unit 221 stored in source protocol address 533d and the virtual MAC Address stored in source hardware address 533c are learned, and the study result is registered into an ARP table. And the ARP reply packet 534 is transmitted as a response to the received packet. Drawing 18 (d) is drawing showing an example of the ARP reply packet 534. In drawing 18 (d), 534a is a destination MAC Address, 534b is a transmitting agency MAC Address, 534c is a source hardware address, 534d is a source protocol address, 534e is a target hardware address, and 534f is a target protocol address. Here, the virtual MA address (MAC_V) is set as destination MAC Address534a and target hardware address 534e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address534b and source hardware address 534c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 534d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 534f.
[0079] In APR packet junction section 501of network connection equipment 200b which received ARP reply packet 534 b, the ARP packet receive section 518 extracts target protocol address 534f in the ARP reply packet 534 concerned. And if the IP address is not an IP address currently used by port 292b, the ARP reply packet 534 will be transmitted to the reply transfer section 527. In the reply transfer section 527, the ARP reply packet 535 equivalent to the received ARP reply packet 534 is transmitted to network connection equipment 100b through communication path 211b set up on backbone network 210b. Drawing 18 (e) is drawing showing an example of the ARP reply packet 535. In drawing 18 (e), 535a is a destination MAC Address, 535b is a transmitting agency MAC Address, 535c is a source hardware address, 535d is a source protocol address, 535e is a target hardware address, and 535f is a target protocol address. Here, a virtual MAC Address (MAC_V) is set as destination MAC Address535a and target hardware address 535e, the MAC Address (MAC_222) of a terminal unit 222 is set as transmitting agency MAC Address535b and source hardware address 535c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 535d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 535f.
[0080] In network connection equipment 100b which received the ARP reply packet 535, the backbone packet receive section 521 notifies the ARP reply packet 535 concerned to the subnet selection section 524. In the subnet selection section 524, target protocol address 535f is extracted from the received ARP reply packet 535, and subnet 230b including the address concerned is chosen from the subnets which network connection equipment 100b holds. And the ARP reply packet 535 is notified to the reply packet transducer 522.
[0081] In the reply packet transducer 522 of network connection equipment 100b, target protocol address 535f of the ARP reply packet 535 is extracted. Then, the retrieval section 519 gains the MAC Address corresponding to the target protocol address 535f concerned, and rewrites destination MAC Address535a and target hardware address 535e based on the acquisition result. Moreover, in the reply packet transducer 522, transmitting agency MAC Address 535b and source hardware address 535c are rewritten to virtual MAC Address MAC_V currently used by port 291b. And in the reply packet transmitting section 523, the ARP reply packet 536 after rewriting is transmitted from port 291b linked to subnet 230b. Drawing 18 (f) is drawing showing an example of the ARP reply packet 536. In drawing 18 R> 8 (f), 536a is a destination MAC Address, 536b is a transmitting agency MAC Address, 536c is a source hardware address, 536d is a source protocol address, 536e is a target hardware address, and 536f is a target protocol address. Here, the MAC Address (MAC_221) of a terminal unit 221 is set as destination MAC Address536a and target hardware address 536e, a virtual MAC Address (MAC_V) is set as transmitting agency MAC Address536b and source hardware address 536c, the IP address (IP_222) of a terminal unit 222 is set as source protocol address 536d, and the IP address (IP_221) of a terminal unit 221 is set as target protocol address 536f.
[0082] In the terminal unit 221 which received the ARP reply packet 536, the virtual MAC Address stored in source hardware address 536c is learned as a MAC Address corresponding to

the IP address of a terminal unit 222, and it registers with an ARP table.
[0083] Henceforth, packet transmission to a terminal unit 222 from a terminal unit 221 is performed to a virtual MAC Address, and it is the same procedure as the gestalt 1 of operation, and hooks up to the network connection equipments 100b and 200b. Moreover, also with the packet transmission to a terminal unit 221 from a terminal unit 222, since the virtual MAC Address is registered into the ARP table, it is carried out to a virtual MAC Address. Thereby, a mutual communication link is attained.
[0084] Thus, in the gestalt of this operation, even when subnet 230b is divided, each network connection equipment can write as the configuration which relays an ARP packet via a backbone network, and it can newly communicate between the divided terminal units with which the entry is not registered from the first. Moreover, in the gestalt of this operation, address solution can be performed through a backbone network also with the terminal unit set up so that it might not answer to the ICMP request message transmitted to the broadcast address. Moreover, in the terminal unit connected to the subnet, it is transmitting and receiving an ARP request packet and an ARP response packet, and since an ARP table is updated, the communication link using a backbone network is attained, without adding special processing.
[0085] Gestalt 4. drawing 19 of operation is drawing showing the configuration of the gestalt 4 of operation of the network connection equipment concerning this invention. In drawing 19 , 100c is network connection equipment, 101c is the condition check section, 103c is the contact information-interchange section, 104c is the packet transmitting section, 107c is the Records Department, 174c is the subnet selection section, 175c is the transfer packet generation section, and 641c is the recovery packet generation section. in addition, about above-mentioned network connection equipment 100c, condition check section 101c, contact information-interchange section 103c, packet transmitting section 104c, Records Department 107c, subnet selection section 174c, and transfer packet generation section 175c It is premised on including the same function as the condition check section in the gestalten 1 or 2 of the operation previously explained, respectively in addition to the characteristic function in the gestalt of this operation, the contact information-interchange section, the packet transmitting section, the Records Department, the subnet selection section, and the transfer packet generation section.
[0086] Moreover, drawing 20 is drawing showing an example of a network system which used the network connection equipment of the gestalt 4 of operation. In drawing 20 , 200c is network connection equipment. In addition, about the same configuration as the gestalten 1 or 2 of the operation explained previously, the same sign is attached and the explanation is omitted.
[0087] Here, actuation of the above-mentioned network connection equipment is explained using drawing 19 and drawing 20 . In addition, the gestalt of this operation explains only different actuation from the gestalten 1 or 2 of the operation explained previously. Moreover, the network connection equipments 100c and 200c take a redundant configuration, and the network system of the gestalt of this operation connects a backbone network 210 and a subnet 230. moreover -- the gestalt of this operation -- network connection equipment 100c -- as a standby router -- network connection equipment 200c -- present -- business -- as a router, it operates, respectively and is further premised on the condition that the switching hub 232 broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107of network connection equipment 100c c, and the entry shown in drawing 24 was registered into Records Department 107of network connection equipment 200c c.
[0088] However, drawing 21 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221, in the entry at the time of failure generating shown in drawing 21 (a), 625a is an IP address, 626a is [ 625b is a MAC Address, ] an IP address in the entry of forward always shown in drawing 21 (b), and 626b is a MAC Address. Moreover, drawing 22 is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222, in the entry at the time of failure generating shown in drawing 22 (a), 627a is an IP address, 628a is [ 627b is a MAC Address, ] an IP address in the entry of forward always shown in drawing 22 (b), and 628b

is a MAC Address. Moreover, drawing 23 is the example of the entry recorded on Records Department 107of network connection equipment 100c c, in drawing 23 , 652a is an IP address and 652b is a MAC Address. Moreover, drawing 24 is the example of the entry recorded on Records Department 107of network connection equipment 200c c, in drawing 24 , 653a is an IP address and 653b is a MAC Address.

[0089] In this condition, if a switching hub 232 is recovered, in condition check section 101of network connection equipment 100c c, the flow of ping, the VRRP message reception from network connection equipment 200c, etc. will detect failure recovery of a subnet 230, and the purport to which self-equipment operates as a standby router to network connection equipment 200c via a communication path 211 will be notified.

[0090] In network connection equipment 200c which received the above-mentioned notice, condition check section 101c notifies that to recovery packet generation section 641c. In recovery packet generation section 641c, an ARP reply packet is generated with reference to Records Department 107c of self-equipment based on an entry. Drawing 25 is drawing showing an example of an ARP reply packet format. the ARP reply packet of network connection equipment 100c shown in drawing 25 (a) -- it is, 660a is a destination MAC Address, 660b is a transmitting agency MAC Address, 660c is a source hardware address, 660d is a source protocol address, 660e is a target hardware address, and 660f is a target protocol address. the ARP reply packet of network connection equipment 200c shown in drawing 25 (b) -- it is, 661a is a destination MAC Address, 661b is a transmitting agency MAC Address, 661c is a source hardware address, 661d is a source protocol address, 661e is a target hardware address, and 661f is a target protocol address.

[0091] Here, as shown in drawing 25 (b), IP address 653a (IP_222) is set as target protocol address 661f. MAC Address 653b (MAC_222) is set as target hardware address 661e. The IP address (IP_V) currently used for source protocol address 661d in the port 292 is set up. The virtual MAC Address (MAC_V) currently used for source hardware address 661c and transmitting agency MAC Address 661b in the port 292 is set up, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 661a.

[0092] In packet transmitting section 104of network connection equipment 200c c, the ARP reply packet generated as mentioned above is transmitted from a port 292.

[0093] At this time, the entry of the ARP table shown in drawing 21 (a) is updated like drawing 21 (b) with the terminal unit 221 which received the ARP reply packet based on target hardware address 661e and target protocol address 661f contained in the packet concerned.

[0094] On the other hand, since network connection equipment 100c becomes a standby router, it cannot perform the communication link which used the virtual address on the subnet 230. Then, the information which network connection equipment 100c holds is transmitted to network connection equipment 200c, and an ARP reply packet is transmitted from network connection equipment 200c. Speaking concretely, by network connection equipment 100c, transfer packet generation section 175c's generating an ARP reply packet based on the entry currently recorded on Records Department 107c, if condition check section 101c detects failure recovery of a subnet 230. Here, as shown in drawing 25 (a), IP address 652a (IP_221) is set as target protocol address 660f, MAC Address 652b (MAC_221) is set as target hardware address 660e, a virtual IP address (IP_V) is set as source protocol address 660d, a virtual MAC Address (MAC_V) is set as source hardware address 660c and transmitting agency MAC Address 660b, and a broadcast address (MAC_Broadcast) is set as destination MAC Address 660a.

[0095] In contact information-interchange section 103of network connection equipment 100c c, contact information is transmitted to network connection equipment 200c in the form of the ARP reply packet generated as mentioned above.

[0096] In network connection equipment 200c which received the above-mentioned contact information, i.e., an ARP reply packet, since subnet selection section 174c is reception from a backbone network 210 and a transmitting agency MAC Address is a virtual MAC Address of a port 292, it identifies that the destination is a subnet 230. And in packet transmitting section 104c, the packet concerned is transmitted from a port 292.

[0097] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table

shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.
[0098] Thus, in the gestalt of this operation, when the failure of a subnet 230 is recovered, each terminal unit can write as the configuration which rewrites the entry of the ARP table updated by the failure in the condition (always [ forward ]) of a basis, and can continue the communication link between terminal units by direct assignment of a mutual MAC Address henceforth. Moreover, in the gestalt of this operation, it writes as the configuration which rewrites an ARP table by general actuation of ARP, and each terminal unit connected to the subnet 230 can choose a communication path, without adding special processing.
[0099] Gestalt 5. drawing 26 of operation is drawing showing the configuration of the gestalt 5 of operation of the network connection equipment concerning this invention. In drawing 26 , 100d is network connection equipment, 103d is the contact information-interchange section, 173d is the packet generation section, and 174d is the subnet selection section.
[0100] Moreover, drawing 27 is drawing showing an example of a network system which used the network connection equipment of the gestalt 5 of operation. In drawing 27 , 200d is network connection equipment. In addition, about the same configuration as the gestalten 1-4 of the operation explained previously, the same sign is attached and the explanation is omitted.
[0101] Here, actuation of the above-mentioned network connection equipment is explained using drawing 26 and drawing 27 . In addition, the gestalt of this operation explains only different actuation from the gestalten 1-4 of the operation explained previously. Moreover, the network system of the gestalt of this operation takes 100d of network connection equipment, and a configuration with redundant 200d, and connects a backbone network 210 and a subnet 230. moreover -- the gestalt of this operation -- 100d of network connection equipment -- as a standby router -- 200d of network connection equipment -- present -- business -- as a router, it operates, respectively and is further premised on the condition that the switching hub 232 broke down. Namely, it is premised on the condition that the entry shown in the ARP table 223 of a terminal unit 221 at drawing 21 (a) was registered in the same procedure as the gestalt 2 of operation, the entry shown in the ARP table 224 of a terminal unit 222 at drawing 22 (a) was registered, the entry shown in drawing 23 was registered into Records Department 107of network connection equipment 100c c, and the entry shown in drawing 24 R> 4 was registered into Records Department 107of network connection equipment 200c c.
[0102] In this condition, if a switching hub 232 is recovered, by 100d of network connection equipment, the ARP reply packet shown in drawing 25 will be generated like the gestalt 4 of the above-mentioned operation, and the ARP reply packet concerned will be transmitted from a port 292. And in a terminal unit 221, the entry of the ARP table shown in drawing 2121 (a) is updated like drawing 21 (b).
[0103] On the other hand, since 100d of network connection equipment serves as a standby router, it cannot perform the communication link which used the virtual address on the subnet 230. So, with 200d of network connection equipment, if condition check section 101c detects failure recovery of a subnet 230, 103d of contact information-interchange sections will generate contact information based on the entry currently recorded on Records Department 107c, and they will transmit the contact information concerned to 200d of network connection equipment. That is, with reference to the contents of the entry of drawing 23 , IP address 652a and MAC Address 652b are transmitted as contact information.
[0104] At 103d of contact information-interchange sections of 200d of network connection equipment which received contact information, the IP address included in the information concerned is transmitted to 174d of subnet selection sections, and in 174d of subnet selection sections, the subnet 230 in which the received IP address is included is chosen from the subnets which 100d of network connection equipment holds, and it notifies to 173d of packet generation sections.
[0105] In 173d of packet generation sections of 200d of network connection equipment, as shown in drawing 25 (a), an ARP reply packet is generated. And in packet transmitting section 104c, the received ARP reply packet is transmitted from a port 292.
[0106] In the terminal unit 222 which received the ARP reply packet, the entry of the ARP table

shown in drawing 22 (a) is updated like drawing 22 (b) based on target hardware address 660e and target protocol address 660f contained in the packet concerned.
[0107] Thus, while writing as contact information as the configuration which sends only the combination of an IP address and a MAC Address and acquiring the same effectiveness as the gestalt 4 of the above-mentioned operation, as compared with the case where an ARP packet is transmitted, the traffic volume of a backbone network is sharply reducible in the gestalt of this operation, further. Moreover, in the gestalt of this operation, by the case where an ARP reply packet is generated based on the entry recorded on the Records Department of self-equipment, and the case where an ARP reply packet is generated based on the contact information acquired from other network connection equipments, since processing is the same, mounting can be simplified.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the configuration of the gestalt 1 of operation of the network connection equipment concerning this invention.
[Drawing 2] It is drawing showing an example of the network system using the network connection equipment of the gestalt 1 of operation.
[Drawing 3] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221.
[Drawing 4] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222.
[Drawing 5] It is drawing showing the MAC frame from a terminal unit 221 to a terminal unit 222.
[Drawing 6] It is drawing showing the configuration of the contact information gathering section 102.
[Drawing 7] It is drawing showing an example of a MAC frame format which stores an ICMP echo request message.
[Drawing 8] It is drawing showing an example of a MAC frame format which stores an ICMP echo reply message.
[Drawing 9] It is drawing showing an example of an ARP reply packet format.
[Drawing 10] It is drawing showing the configuration of the gestalt 2 of operation of the network connection equipment concerning this invention.
[Drawing 11] It is drawing showing an example of the network system using the network connection equipment of the gestalt 2 of operation.
[Drawing 12] It is drawing showing an example of an ARP reply packet format.
[Drawing 13] It is drawing showing an example of the entry after updating (ARP table 224).
[Drawing 14] It is drawing showing an example of the entry after updating (ARP table 223).
[Drawing 15] It is drawing showing the configuration of the gestalt 3 of operation of the network connection equipment concerning this invention.
[Drawing 16] It is drawing showing the configuration of ARP packet junction section 501b.
[Drawing 17] It is drawing showing an example of the network system using the network connection equipment of the gestalt 3 of operation.
[Drawing 18] It is drawing showing an example of a format of an ARP request packet and an ARP reply packet.
[Drawing 19] It is drawing showing the configuration of the gestalt 4 of operation of the network connection equipment concerning this invention.
[Drawing 20] It is drawing showing an example of the network system using the network connection equipment of the gestalt 4 of operation.
[Drawing 21] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 221.
[Drawing 22] It is drawing showing an example of the entry recorded on the ARP table of a terminal unit 222.
[Drawing 23] It is the example of the entry recorded on Records Department 107of network connection equipment 100c c.

[Drawing 24] It is the example of the entry recorded on Records Department 107of network connection equipment 200c c.
[Drawing 25] It is drawing showing an example of an ARP reply packet format.
[Drawing 26] It is drawing showing the configuration of the gestalt 5 of operation of the network connection equipment concerning this invention.
[Drawing 27] It is drawing showing an example of the network system using the network connection equipment of the gestalt 5 of operation.
[Drawing 28] It is drawing showing the conventional structure of a system.
[Drawing 29] It is drawing showing the configuration of the network system using VRRP.
[Drawing 30] It is drawing showing the outline of an ARP reply packet format in which it is used by VRRP.
[Description of Notations]
100,100a, 100b, 100c, 100d, 200,200a, 200b, 200c, 200d Network connection equipment, 101,101a, 101c The condition check section, 102 Contact information gathering section, 103,103a, 103c, 103d The contact information-interchange section, 104,104c Packet transmitting section, The 105 junction sections, 106 A comparator, 107,107b, 107c Records Department, 108 An ARP table, 173,173d Packet generation section, 174,174a, 174c, 174d The subnet selection section, and 175a and 175c Transfer packet generation section, 210,210b A backbone network, 211,211b Communication path, 221,222,227 A terminal unit, 223,224 ARP table, 230,230b, 240b, 250b A subnet, 231,232,233,234 switching hubs, 281, 282, 283, 284, 285, 286, 287, 288,289,291,291b, 292,292b, a 293,293b port, 441 The request transmitting section, 442 A receive section, 443 Study section, 501b The ARP packet junction section, 504 Subnet fragmentation part, 518 An ARP packet receive section, 519 The retrieval section, 520 Request transfer section, 521 A backbone packet receive section, 522 Reply packet transducer, 523 The reply packet transmitting section, 524 The subnet selection section, 525 A request packet transducer, 526 The request packet transmitting section, 527 The reply transfer section, 641c Recovery packet generation section.

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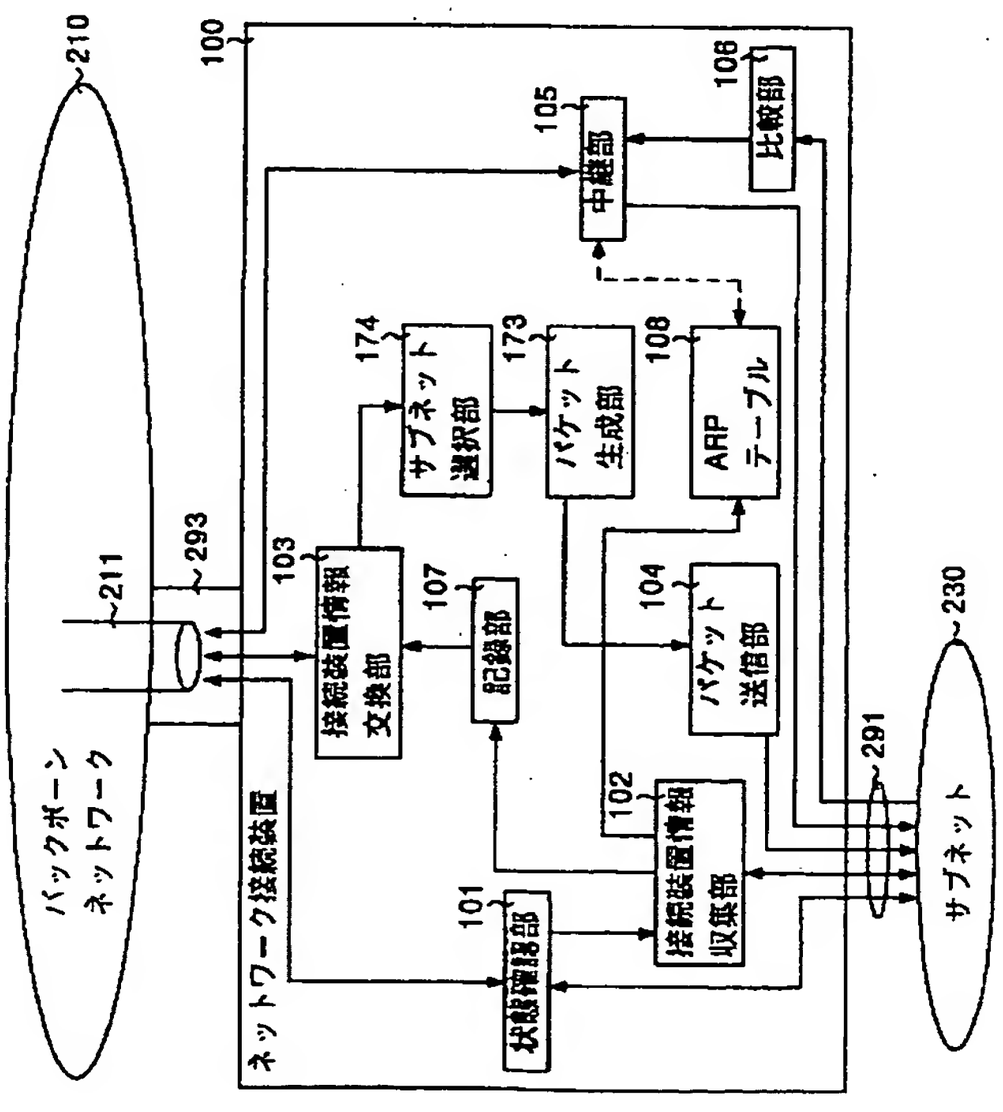
(54)【発明の名称】　ネットワークシステムおよびネットワーク接続装置

(57)【要約】
【課題】　故障によりサブネット内で各端末が分断された場合に、端末間の通信を継続可能なネットワーク接続装置を得ること。
【解決手段】　サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視する状態確認部１０１と、サブネット内の各端末装置が分断されている状態を認識した場合に自装置に接続された端末装置の接続装置情報を収集する接続装置情報収集部１０２と、収集した接続装置情報をバックボーンネットワーク経由で他のネットワーク接続装置と交換する接続装置情報交換部１０３と、受け取った接続装置情報に基づいてＡＲＰリプライパケットを生成するパケット生成部１７３と、ＡＲＰリプライパケットを該当するサブネットに送信するパケット送信部１０４と、を備える構成とする。



【特許請求の範囲】
【請求項１】　バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備えたネットワークシステムにおいて、
前記各ネットワーク接続装置は、
サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、
接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段と、
収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段と、
他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段と、
前記接続装置情報に基づいてＡＲＰリプライパケットを生成し、当該ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット生成／送信手段と、
端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比較手段と、
各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段と、
を備え、
前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とするネットワークシステム。
【請求項２】　さらに、サブネットからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するＡＲＰパケット受信手段と、
前記ＡＲＰパケット受信手段がＡＲＰリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当する情報が含まれていたかどうかを検索する第１の検索手段と、
前記情報が含まれていない場合に、バックボーンネットワークに前記ＡＲＰリクエストパケットを送信するリクエスト転送手段と、
前記ＡＲＰパケット受信手段がＡＲＰリプライパケットを受信した場合に、バックボーンネットワークに当該ＡＲＰリプライパケットを送信するリプライ転送手段と、
バックボーンネットワークからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信するバックボーンパケット受信手段と、
受信したＡＲＰパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段と、
前記バックボーンパケット受信手段がＡＲＰリクエストパケットを受信した場合に、当該パケットの送信元ＭＡＣアドレスとソースハードウェアアドレスとを仮想ＭＡＣアドレスに書き換えるリクエストパケット変換手段と、
書き換え後のＡＲＰリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段と、
前記バックボーンパケット受信手段がＡＲＰリプライパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてＭＡＣアドレスを検索する第２の検索手段と、
宛先ＭＡＣアドレスおよびターゲットハードウェアアドレスを検索結果であるＭＡＣアドレスに書き換え、ソースハードウェアアドレスを仮想ＭＡＣアドレスに書き換えるリプライパケット変換手段と、
書き換え後のＡＲＰリプライパケットを選択されたサブネットに送信するリプライパケット送信手段と、
を備えることを特徴とする請求項１に記載のネットワークシステム。
【請求項３】　バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備えたネットワークシステムにおいて、
前記各ネットワーク接続装置は、
サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、
接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段と、
収集した接続装置情報に基づいてＡＲＰリプライパケットを生成するパケット生成手段と、
生成したＡＲＰリプライパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段と、
他のネットワーク接続装置から受け取ったＡＲＰリプライパケットに基づいてサブネットを選択するサブネット選択手段と、
前記ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット送信手段と、
端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比

較手段と、
各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段と、
を備え、
前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とするネットワークシステム。
【請求項４】　さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する回復パケット生成手段、
を備え、
前記ＡＲＰリプライパケット送信手段は、前記回復パケット生成手段により生成されたＡＲＰリプライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケット、をサブネットに送信し、
前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのＭＡＣアドレスを直接指定して通信を行うことを特徴とする請求項３に記載のネットワークシステム。
【請求項５】　さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する第１の回復パケット生成手段と、
バックボーンネットワークから、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてＡＲＰリプライパケットを生成する第２の回復パケット生成手段と、
を備え、
前記ＡＲＰリプライパケット生成／送信手段は、前記第１の回復パケット生成手段により生成されたＡＲＰリプライパケット、および第２の回復パケット生成手段により生成されたＡＲＰリプライパケット、をサブネットに送信し、
前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのＭＡＣアドレスを直接指定して通信を行うことを特徴とする請求項１に記載のネットワークシステム。
【請求項６】　前記接続装置情報収集手段は、
ＩＣＭＰエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段と、
前記リクエストに対する応答としてＩＣＭＰエコーリプライメッセージを受信する受信手段と、
前記ＩＣＭＰエコーリプライメッセージに基づいてサブネット内の端末装置のＩＰアドレスとＭＡＣアドレスの組み合わせを学習する学習手段と、
を備えることを特徴とする請求項１～５のいずれか一つに記載のネットワークシステム。
【請求項７】　バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続する各ネットワーク接続装置にあっては、
サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、
接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段と、
収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段と、
他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段と、
前記接続装置情報に基づいてＡＲＰリプライパケットを生成し、当該ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット生成／送信手段と、
端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比較手段と、
各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段と、
を備えることを特徴とするネットワーク接続装置。
【請求項８】　さらに、サブネットからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するＡＲＰパケット受信手段と、
前記ＡＲＰパケット受信手段がＡＲＰリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当する情報が含まれていたかどうかを検索する第１の検索手段と、
前記情報が含まれていない場合に、バックボーンネットワークに前記ＡＲＰリクエストパケットを送信するリクエスト転送手段と、
前記ＡＲＰパケット受信手段がＡＲＰリプライパケットを受信した場合に、バックボーンネットワークに当該ＡＲＰリプライパケットを送信するリプライ転送手段と、
バックボーンネットワークからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信するバックボーンパケット受信手段と、

受信したＡＲＰパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段と、
前記バックボーンパケット受信手段がＡＲＰリクエストパケットを受信した場合に、当該パケットの送信元ＭＡＣアドレスとソースハードウェアアドレスとを仮想ＭＡＣアドレスに書き換えるリクエストパケット変換手段と、
書き換え後のＡＲＰリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段と、
前記バックボーンパケット受信手段がＡＲＰリプライパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてＭＡＣアドレスを検索する第２の検索手段と、
宛先ＭＡＣアドレスおよびターゲットハードウェアアドレスを検索結果であるＭＡＣアドレスに書き換え、ソースハードウェアアドレスを仮想ＭＡＣアドレスに書き換えるリプライパケット変換手段と、
書き換え後のＡＲＰリプライパケットを選択されたサブネットに送信するリプライパケット送信手段と、
を備えることを特徴とする請求項７に記載のネットワーク接続装置。
【請求項９】　バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続する各ネットワーク接続装置にあっては、
サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、
接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段と、
収集した接続装置情報に基づいてＡＲＰリプライパケットを生成するパケット生成手段と、
生成したＡＲＰリプライパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段と、
他のネットワーク接続装置から受け取ったＡＲＰリプライパケットに基づいてサブネットを選択するサブネット選択手段と、
前記ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット送信手段と、
端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比較手段と、
各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段と、
を備えることを特徴とするネットワーク接続装置。
【請求項１０】　さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する回復パケット生成手段、
を備え、
前記ＡＲＰリプライパケット送信手段は、前記回復パケット生成手段により生成されたＡＲＰリプライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケット、をサブネットに送信することを特徴とする請求項９に記載のネットワーク接続装置。
【請求項１１】　さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する第１の回復パケット生成手段と、
バックボーンネットワークから、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてＡＲＰリプライパケットを生成する第２の回復パケット生成手段と、
を備え、
前記ＡＲＰリプライパケット生成／送信手段は、前記第１の回復パケット生成手段により生成されたＡＲＰリプライパケット、および第２の回復パケット生成手段により生成されたＡＲＰリプライパケット、をサブネットに送信することを特徴とする請求項７に記載のネットワーク接続装置。
【請求項１２】　前記接続装置情報収集手段は、
ＩＣＭＰエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段と、
前記リクエストに対する応答としてＩＣＭＰエコーリプライメッセージを受信する受信手段と、
前記ＩＣＭＰエコーリプライメッセージに基づいてサブネット内の端末装置のＩＰアドレスとＭＡＣアドレスの組み合わせを学習する学習手段と、
を備えることを特徴とする請求項７～１１のいずれか一つに記載のネットワーク接続装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置を備えたネットワークシステムに関するものであり、特に、サブネット分断時の端末間の通信を救済可能なネットワークシステムおよびネットワーク接続装置に関するものである。
【０００２】
【従来の技術】以下、従来技術について説明する。ＩＰ（Internet Protocol）ネットワークにおいて、ルータ

によって他のネットワークと区切られたサブネットは、ルータを経由して当該サブネットの外部と通信を行う。しかしながら、ルータが故障した場合にはサブネットの外部と通信が行えなくなるため、たとえば、複数のルータを用いて通信経路の冗長化を行うことが一般的に知られている。

【０００３】複数のルータを用いて通信経路の冗長化を行うシステムとしては、たとえば、特開平１１－２６１６２０号公報に記載の「ルータ障害における配下ＬＡＮの救済機能を有するルータネットワーク」がある。図２８は、従来のシステムの構成を示す図である。図２８において、１０は現用ルータであり、１１は代理ルータであり、１２は他のルータであり、１３はＡＴＭネットワークであり、１４はルータが冗長化されたサブネットである。

【０００４】上記公報記載の技術では、サブネット１４に１つの現用ルータ１０と現用ルータ１０とは別の代理ルータ１１とを用意する。このとき、現用ルータ１０のネットワーク環境を代理ルータ１１にもあらかじめ設定しておき、代理ルータ１１では、ｐｉｎｇパケット等により現用ルータ１０を監視する。そして、現用ルータ１０が障害となった場合には、現用ルータ１０で使用していたＭＡＣ（Media Access Control）アドレスを代理ルータ１１が引き継ぎ、代理ルータ１１が、現用ルータ１０に成り代わって動作する。具体的にいうと、現用ルータ１０が障害となった場合には、代理ルータ１１が、現用ルータ１０にて使用している物理アドレスを引き継ぎ、サブネット外への通信フレームの中継を代行する。これにより、サブネット１４と他のサブネットとの接続性を確保できる。

【０００５】また、複数のルータを用いて通信経路の冗長化を行うシステムとしては、上記以外に、ＶＲＲＰ（Virtual Router Redundancy Protocol, Internet Engineering Task Force:IETF RFC2338）を用いたネットワークシステムがある。

【０００６】ＶＲＲＰでは、複数のルータが仮想ルータを構成し、仮想ＭＡＣアドレスと共通のＩＰアドレスを共有する。現用ルータは、定期的にＶＲＲＰメッセージをサブネット内に送信することで仮想ＭＡＣアドレスとＩＰアドレスを待機ルータに通知し、現用ルータの健在を知らしめる。一方、待機ルータは、一定時間、現用ルータからのＶＲＲＰメッセージの到着がないことをもって現用ルータの障害を検知し、仮想ＭＡＣアドレスとＩＰアドレスを使用して代理動作を行う。

【０００７】図２９は、ＶＲＲＰを用いたネットワークシステムの構成を示す図である。図２９において、２０，２１はルータであり、２３，２４，２５はスイッチングハブであり、２６，２７は端末装置であり、２８はサブネットであり、２９はバックボーンネットワークである。

【０００８】また、図３０は、ＶＲＲＰで用いられるＡＲＰ（Address Resolution Protocol）リプライパケットフォーマットの概略を示す図である。図３０において、３０ａは宛先ＭＡＣアドレス（ＭＡＣ＿ＤＡ）であり、３０ｂは送信元ＭＡＣアドレス（ＭＡＣ＿ＳＡ）であり、３０ｃはソースハードウェアアドレス（ＳＲＣ＿ＭＡＣ＿ＡＤＤＲ）であり、３０ｄはソースプロトコルアドレス（ＳＲＣ＿ＩＰ＿ＡＤＤＲ）であり、３０ｅはターゲットハードウェアアドレス（ＴＡＧＴ＿ＭＡＣ＿ＡＤＤＲ）であり、３０ｆはターゲットプロトコルアドレス（ＴＡＧＴ＿ＩＰ＿ＡＤＤＲ）である。

【０００９】端末装置２６および２７では、デフォルトルートとして仮想ＭＡＣアドレスを設定しておくと、サブネット外への通信フレームを仮想ＭＡＣアドレス宛に送信する。たとえば、ルータ２０が現用ルータとして、ルータ２１が待機ルータとして動作している場合、通信フレームは、ルータ２０が中継する。

【００１０】そして、現用ルータ２０が故障すると、待機ルータ２１では、図３０に示すＡＲＰリプライパケットをサブネット２８に対して送信する。すなわち、待機ルータ２１では、仮想ＭＡＣアドレスを送信元ＭＡＣアドレス３０ｂおよびソースハードウェアアドレス３０ｃに格納し、共有ＩＰアドレスをソースプロトコルアドレス３０ｄに格納し、ブロードキャストアドレスを宛先ＭＡＣアドレス３０ａに格納し、この状態でＡＲＰリプライパケットをサブネット２８に対して送信する。

【００１１】また、各スイッチングハブでは、上記ＡＲＰリプライパケットを受信および転送し、仮想ＭＡＣアドレスの装置がルータ２１の方向のポートにあることを学習し、以後、仮想ＭＡＣアドレス宛のＭＡＣフレームをルータ２１の方向に転送する。これにより、現用ルータ２０が故障した場合においても、サブネット２７と他のサブネットとの接続性を確保できる。

【００１２】

【発明が解決しようとする課題】しかしながら、上記、複数のルータが冗長接続されたシステムでは、サブネットが分断された場合に、別々のセグメントに接続する各端末装置が物理的には他のネットワークを経由して接続されているにもかかわらず、相互の通信を行うことができなくなる、という問題があった。

【００１３】たとえば、図２９において、スイッチングハブ２４が故障した場合は、端末装置２６から端末装置２７へのＡＲＰリクエストパケットが導通不能となり、通信を行うことができない。また、端末装置２６のＡＲＰテーブルに端末装置２７のエントリが格納されていた場合については、端末装置２６が宛先ＭＡＣアドレスに端末装置２７のＭＡＣアドレスを設定し端末装置２７へのパケットを送信するが、スイッチングハブ２４の故障により当該パケットの中継が不可能となり、通信が途絶えてしまう。

【００１４】本発明は、上記に鑑みてなされたものであって、サブネットと他のネットワークとが冗長接続されたシステムにおいて、たとえば、故障によりサブネット内で各端末が分断された場合においても、端末間の通信を継続可能なネットワーク接続装置を得ることを目的とする。

【００１５】

【課題を解決するための手段】上述した課題を解決し、目的を達成するために、本発明にかかるネットワークシステムにあっては、バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備え、前記各ネットワーク接続装置は、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段（後述する実施の形態の状態確認部１０１に相当）と、接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段（接続装置情報収集部１０２に相当）と、収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段（接続装置情報交換部１０３に相当）と、他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段（サブネット選択部１７４に相当）と、前記接続装置情報に基づいてＡＲＰリプライパケットを生成し、当該ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット生成／送信手段（パケット生成部１７３、パケット送信部１０４に相当）と、端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比較手段（比較部１０６に相当）と、各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段（中継部１０５に相当）と、を備え、前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とする。

【００１６】つぎの発明にかかるネットワークシステムにあっては、さらに、サブネットからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するＡＲＰパケット受信手段（ＡＲＰパケット受信部５１８に相当）と、前記ＡＲＰパケット受信手段がＡＲＰリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当する情報が含まれていたかどうかを検索する第１の検索手段（検査部５１９に相当）と、前記情報が含まれていない場合に、バックボーンネットワークに前記ＡＲＰリクエストパケットを送信するリクエスト転送手段（リクエスト転送部５２０に相当）と、前記ＡＲＰパケット受信手段がＡＲＰリプライパケットを受信した場合に、バックボーンネットワークに当該ＡＲＰリプライパケットを送信するリプライ転送手段（リプライ転送部５２７に相当）と、バックボーンネットワークからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信するバックボーンパケット受信手段（バックボーンパケット受信部５２１に相当）と、受信したＡＲＰパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段（サブネット選択部５２４に相当）と、前記バックボーンパケット受信手段がＡＲＰリクエストパケットを受信した場合に、当該パケットの送信元ＭＡＣアドレスとソースハードウェアアドレスとを仮想ＭＡＣアドレスに書き換えるリクエストパケット変換手段（リクエストパケット変換部５２５に相当）と、書き換え後のＡＲＰリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段（リクエストパケット送信部５２６に相当）と、前記バックボーンパケット受信手段がＡＲＰリプライパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてＭＡＣアドレスを検索する第２の検索手段（検索部５１９に相当）と、宛先ＭＡＣアドレスおよびターゲットハードウェアアドレスを検索結果であるＭＡＣアドレスに書き換え、ソースハードウェアアドレスを仮想ＭＡＣアドレスに書き換えるリプライパケット変換手段（リプライパケット変換部５２２に相当）と、書き換え後のＡＲＰリプライパケットを選択されたサブネットに送信するリプライパケット送信手段（リプライパケット送信部５２３に相当）と、を備えることを特徴とする。

【００１７】つぎの発明にかかるネットワークシステムにあっては、バックボーンネットワークと、複数の端末装置を収容するサブネットと、バックボーンネットワークとサブネットとを冗長接続する複数のネットワーク接続装置と、を備え、前記各ネットワーク接続装置は、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段（状態確認部１０１ａに相当）と、接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報に基づいてＡＲＰリプライパケットを生成す

るパケット生成手段（転送パケット生成部１７５ａに相当）と、生成したＡＲＰリプライパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段（接続装置情報交換部１０３ａに相当）と、他のネットワーク接続装置から受け取ったＡＲＰリプライパケットに基づいてサブネットを選択するサブネット選択手段（サブネット選択部１７４ａに相当）と、前記ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット送信手段（パケット送信部１０４に相当）と、端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比較手段と、各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段と、を備え、前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルを更新し、以降、分断された端末装置とはバックボーンネットワークを介して通信を行うことを特徴とする。

【００１８】つぎの発明にかかるネットワークシステムにあっては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する回復パケット生成手段（回復パケット生成部６４１ｃに相当）、を備え、前記ＡＲＰリプライパケット送信手段は、前記回復パケット生成手段により生成されたＡＲＰリプライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケット、をサブネットに送信し、前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのＭＡＣアドレスを直接指定して通信を行うことを特徴とする。

【００１９】つぎの発明にかかるネットワークシステムにあっては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する第１の回復パケット生成手段（回復パケット生成部６４１ｃに相当）と、バックボーンネットワークから、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてＡＲＰリプライパケットを生成する第２の回復パケット生成手段（パケット生成部１７３ｄに相当）と、を備え、前記ＡＲＰリプライパケット生成／送信手段は、前記第１の回復パケット生成手段により生成されたＡＲＰリプライパケット、および第２の回復パケット生成手段により生成されたＡＲＰリプライパケット、をサブネットに送信し、前記各端末装置は、受け取ったＡＲＰリプライパケットに基づいてＡＲＰテーブルをもとに戻し、以降、同一サブネット上の端末装置間ではお互いのＭＡＣアドレスを直接指定して通信を行うことを特徴とする。

【００２０】つぎの発明にかかるネットワークシステムにおいて、前記接続装置情報収集手段は、ＩＣＭＰエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段（リクエスト送信部４４１に相当）と、前記リクエストに対する応答としてＩＣＭＰエコーリプライメッセージを受信する受信手段（受信部４４２に相当）と、前記ＩＣＭＰエコーリプライメッセージに基づいてサブネット内の端末装置のＩＰアドレスとＭＡＣアドレスの組み合わせを学習する学習手段（学習部４４３に相当）と、を備えることを特徴とする。

【００２１】つぎの発明にかかるネットワーク接続装置にあっては、バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続し、たとえば、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報を、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換する接続装置情報交換手段と、他のネットワーク接続装置から受け取った装置接続情報に基づいてサブネットを選択するサブネット選択手段と、前記接続装置情報に基づいてＡＲＰリプライパケットを生成し、当該ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット生成／送信手段と、端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比較手段と、各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段と、を備えることを特徴とする。

【００２２】つぎの発明にかかるネットワーク接続装置にあっては、さらに、サブネットからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信し、当該パケットからターゲットプロトコルアドレスを抽出するＡＲＰパケット受信手段と、前記ＡＲＰパケット受信手段がＡＲＰリクエストパケットを受信した場合に、前記収集した接続装置情報の中に当該ターゲットプロトコルアドレスに該当する情報が含まれていたかどうかを検索する第１の検索手段と、前記情報が含まれていない場合に、バックボーンネットワークに前記ＡＲＰリクエストパケットを送信するリクエスト転送手段と、前記ＡＲＰパケット受信手段がＡＲＰリプライパケットを受信した

場合に、バックボーンネットワークに当該ＡＲＰリプライパケットを送信するリプライ転送手段と、バックボーンネットワークからＡＲＰリクエストパケットまたはＡＲＰリプライパケットを受信するバックボーンパケット受信手段と、受信したＡＲＰパケットからターゲットプロトコルアドレスを抽出し、収容する単一または複数のサブネットの中から当該ターゲットプロトコルアドレスが含まれるサブネットを選択するサブネット選択手段と、前記バックボーンパケット受信手段がＡＲＰリクエストパケットを受信した場合に、当該パケットの送信元ＭＡＣアドレスとソースハードウェアアドレスとを仮想ＭＡＣアドレスに書き換えるリクエストパケット変換手段と、書き換え後のＡＲＰリクエストパケットを選択されたサブネットに送信するリクエストパケット送信手段と、前記バックボーンパケット受信手段がＡＲＰリプライパケットを受信した場合に、前記サブネット選択手段が抽出したターゲットプロトコルアドレスに基づいてＭＡＣアドレスを検索する第２の検索手段と、宛先ＭＡＣアドレスおよびターゲットハードウェアアドレスを検索結果であるＭＡＣアドレスに書き換え、ソースハードウェアアドレスを仮想ＭＡＣアドレスに書き換えるリプライパケット変換手段と、書き換え後のＡＲＰリプライパケットを選択されたサブネットに送信するリプライパケット送信手段と、を備えることを特徴とする。

【００２３】つぎの発明にかかるネットワーク接続装置にあっては、バックボーンネットワークと複数の端末装置を収容するサブネットとを冗長接続し、たとえば、サブネットおよびバックボーンネットワークを用いて同一サブネットに接続された他のネットワーク接続装置との導通状態を監視し、サブネット内の各端末装置が分断されている状態を認識した場合に接続装置情報の収集を指示する状態監視手段と、接続装置情報の収集指示により、同一サブネット上の全端末装置のＩＰアドレスとＭＡＣアドレスを接続装置情報として収集する接続装置情報収集手段と、収集した接続装置情報に基づいてＡＲＰリプライパケットを生成するパケット生成手段と、生成したＡＲＰリプライパケットを、バックボーンネットワークを用いて同一サブネットに接続される他のネットワーク接続装置と交換するパケット交換手段と、他のネットワーク接続装置から受け取ったＡＲＰリプライパケットに基づいてサブネットを選択するサブネット選択手段と、前記ＡＲＰリプライパケットを選択されたサブネットに送信するＡＲＰリプライパケット送信手段と、端末装置からＩＰパケットを受け取った場合に、宛先ＩＰアドレスと自装置のもつＩＰアドレスとを比較する比較手段と、各ＩＰアドレスが異なる場合に、前記ＩＰパケットを、バックボーンネットワークを介して他のネットワーク装置に対して送信するＩＰパケット送信手段と、を備えることを特徴とする。

【００２４】つぎの発明にかかるネットワーク接続装置にあっては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する回復パケット生成手段、を備え、前記ＡＲＰリプライパケット送信手段は、前記回復パケット生成手段により生成されたＡＲＰリプライパケット、およびバックボーンネットワークから受信した、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケット、をサブネットに送信することを特徴とする。

【００２５】つぎの発明にかかるネットワーク接続装置にあっては、さらに、サブネットが回復した場合に、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すためのＡＲＰリプライパケットを生成する第１の回復パケット生成手段と、バックボーンネットワークから、当該サブネットに接続された端末装置のＡＲＰテーブルをもとに戻すための接続装置情報を受け取った場合に、当該接続装置情報に基づいてＡＲＰリプライパケットを生成する第２の回復パケット生成手段と、を備え、前記ＡＲＰリプライパケット生成／送信手段は、前記第１の回復パケット生成手段により生成されたＡＲＰリプライパケット、および第２の回復パケット生成手段により生成されたＡＲＰリプライパケット、をサブネットに送信することを特徴とする。

【００２６】つぎの発明にかかるネットワーク接続装置において、前記接続装置情報収集手段は、ＩＣＭＰエコーリクエストメッセージをブロードキャストアドレスで送信するリクエスト送信手段と、前記リクエストに対する応答としてＩＣＭＰエコーリプライメッセージを受信する受信手段と、前記ＩＣＭＰエコーリプライメッセージに基づいてサブネット内の端末装置のＩＰアドレスとＭＡＣアドレスの組み合わせを学習する学習手段と、を備えることを特徴とする。

【００２７】

【発明の実施の形態】以下に、本発明にかかるネットワークシステムおよびネットワーク接続装置の実施の形態を図面に基づいて詳細に説明する。なお、この実施の形態によりこの発明が限定されるものではない。

【００２８】実施の形態１．図１は、本発明にかかるネットワーク接続装置の実施の形態１の構成を示す図である。図１において、１００はネットワーク接続装置であり、１０１は状態確認部であり、１０２は接続装置情報収集部であり、１０３は接続装置情報交換部であり、１０４はパケット送信部であり、１０５は中継部であり、１０６は比較部であり、１０７は接続装置情報を記録する記録部であり、１０８はＡＲＰテーブルであり、１７３はパケット生成部であり、１７４はサブネット選択部であり、２１０はバックボーンネットワークであり、２１１はネットワーク接続装置間を結ぶ通信パスであり、２３０はサブネットであり、２９１はサブネットの入出

力ポートであり、２９３はバックボーンネットワークの入出力ポートである。

【００２９】また、図２は、実施の形態１のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図２において、２００は上記ネットワーク接続装置１００と同様の構成を持つネットワーク接続装置であり、２３１，２３２，２３３，２３４はスイッチングハブであり、２２１，２２２，２２７は端末装置であり、２２３は端末装置２２１のＡＲＰテーブルであり、２２４は端末装置２２２のＡＲＰテーブルであり、２８１，２８２，２８３はスイッチングハブ２３１の入出力ポートであり、２８４，２８５はスイッチングハブ２３２の入出力ポートであり、２８６，２８７，２８８，２８９はスイッチングハブ２３３の入出力ポートである。

【００３０】ここで、図１および図２を用いて上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、ネットワーク接続装置１００と２００が冗長な構成をとり、バックボーンネットワーク２１０とサブネット２３０とを接続する。また、ネットワーク接続装置１００が待機ルータとして、ネットワーク接続装置２００が現用ルータとして、それぞれ動作しているものとする。

【００３１】まず、ネットワーク接続装置１００では、状態確認部１０１が、サブネット２３０を経由してネットワーク接続装置２００との導通状態を監視する。この監視は、ｐｉｎｇを用いて行うこととしてもよいし、ＶＲＲＰメッセージ等の監視により行うこととしてもよい。また、ネットワーク接続装置１００の状態確認部１０１では、バックボーンネットワーク２１０上の通信パス２１１を用い、ネットワーク接続装置２００の状態確認部１０１に対して定期的に自装置の動作状態を送信する。ここでいう動作状態とは、待機ルータとして動作しているか、または現用ルータとして動作しているか、を示す情報を意味する。

【００３２】なお、バックボーンネットワーク２１０がＡＴＭ（Asynchronous Transfer Mode）ネットワークの場合には、通信パス２１１の一例として、ＶＣ（virtual channel）を利用する。

【００３３】この状態で、端末装置２２１と端末装置２２２がデータ通信を行う場合、各端末装置では、あらかじめ認識しているお互いのＩＰアドレスと、ＡＲＰにより学習した互いのＭＡＣアドレスと、をＡＲＰテーブルに登録する。なお、図３は、端末装置２２１のＡＲＰテーブルに記録されるエントリ（ＩＰアドレス、ＭＡＣアドレス）の一例を示す図であり（（ａ）は正常時を（ｂ）は障害時を表す）、４８１ａはＩＰアドレス（ＩＰ＿２２２）であり、４８１ｂはＭＡＣアドレス（ＭＡＣ＿２２２）であり、４８２ａはＩＰアドレス（ＩＰ＿２２２）であり、４８２ｂはＭＡＣアドレス（ＭＡＣ＿１００）である。また、図４は、端末装置２２２のＡＲＰテーブルに記録されるエントリの一例を示す図であり（（ａ）は正常時を（ｂ）は障害時を表す）、４８６ａはＩＰアドレス（ＩＰ＿２２１）であり、４８６ｂはＭＡＣアドレス（ＭＡＣ＿２２１）であり、４８７ａはＩＰアドレス（ＩＰ＿２２１）であり、４８７ｂはＭＡＣアドレス（ＭＡＣ＿２００）である。

【００３４】スイッチングハブ２３１では、端末装置２２１から送信されるＡＲＰパケットをポート２８２で受信し、送信元ＭＡＣアドレスに基づいて、端末装置２２１がポート２８２の先に接続されていることを学習する。また、端末装置２２２から送信されるＡＲＰパケットをポート２８３で受信し、送信元ＭＡＣアドレスに基づいて、端末装置２２２がポート２８３の先に接続されていることを学習する。同様に、スイッチングハブ２３２においては、端末装置２２１がポート２８４の先に接続され、端末送信２２２がポート２８５の先に接続されていることを学習し、さらに、スイッチングハブ２３３においては、端末装置２２１がポート２８６の先に接続され、端末装置２２２がポート２８７の先に接続されていることを学習する。

【００３５】上記のように学習した後は、スイッチングハブ２３１では、端末装置２２１のＭＡＣアドレス宛のＭＡＣフレームをポート２８２から出力し、端末装置２２２のＭＡＣアドレス宛のＭＡＣフレームをポート２８３から出力する。図５は、端末装置２２１から端末装置２２２への送信ＭＡＣフレームを示す図である。図５において、３００ａはＭＡＣヘッダ部であり、３００ｂはＩＰフレーム部であり、３０１は宛先ＭＡＣアドレス（ＭＡＣ＿２２２）であり、３０２は送信元ＭＡＣアドレス（ＭＡＣ＿２２１）であり、３０３は宛先ＩＰアドレス（ＩＰ＿２２２）であり、３０４は送信元ＩＰアドレス（ｉＰ＿２２１）である。ここでは、端末装置２２２のＩＰアドレスを宛先ＩＰアドレス３０３に設定し、学習したＭＡＣアドレスを宛先ＭＡＣアドレス３０１に設定し、自端末のＩＰアドレスを送信元ＩＰアドレス３０４に設定し、自端末のＭＡＣアドレスを送信元ＭＡＣアドレス３０２に設定し、その後、ＭＡＣフレームをネットワークへ送信する。

【００３６】そして、上記ＭＡＣフレームは、宛先ＭＡＣアドレス３０１に基づいて、スイッチングハブ２３１のポート２８２および２８３、スイッチングハブ２３２のポート２８４および２８５、スイッチングハブ２３３のポート２８６および２８７、を経由して端末装置２２２に通知される。

【００３７】一方、スイッチングハブ２３２が故障し、中継動作を行えなくなった場合、ネットワーク接続装置１００の状態確認部１０１では、ｐｉｎｇの失敗やＶＲＲＰメッセージの未到着などにより障害発生を認識し、接続装置情報収集部１０２に対して接続装置情報の収集を指示する。そして、通信パス２１１を経由して、ネッ

トワーク接続装置２００に対して、自装置が、以後、現用ルータとして動作する旨を通知する。

【００３８】図６は、接続装置情報収集部１０２の構成を示す図である。図６において、４４１はＩＣＭＰエコーリクエストメッセージをブロードキャストで送信するリクエスト送信部であり、４４２はＩＣＭＰエコーリプライメッセージを受信する受信部であり、４４３はＩＰアドレスとＭＡＣアドレスとの組み合わせを学習する学習部である。ここでは、ネットワーク接続装置１００内の接続装置情報収集部１０２の動作について説明する。なお、ネットワーク接続装置２００内の接続装置情報収集部１０２についても同様に動作する。

【００３９】また、図７は、接続装置情報収集のために用いられるＩＣＭＰエコーリクエストメッセージを格納するＭＡＣフレームフォーマットの一例を示す図である。図７において、４５１はＭＡＣヘッダ部であり、４５２はＩＰヘッダ部であり、４５３はＩＣＭＰメッセージ部であり、４５４は宛先ＭＡＣアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）であり、４５５は送信元ＭＡＣアドレス（ＭＡＣ＿１００）であり、４５６は宛先ＩＰアドレス（ＩＰ＿ＳｕｂｎｅｔＢｒｏａｄｃａｓｔ）であり、４５７は送信元ＩＰアドレス（ＩＰ＿１００）である。

【００４０】ネットワーク接続装置１００内の接続装置情報収集部１０２では、リクエスト送信部４４１が、宛先ＭＡＣアドレス４５４をブロードキャストアドレスとし、宛先ＩＰアドレス４５６をサブネット２３０へのブロードキャストアドレスとすることで生成したＩＣＭＰエコーリクエストメッセージを、サブネット２３０のポート２９１に送信する。このメッセージは、スイッチングハブ２３１で中継され、端末装置２２１に通知される。

【００４１】ＩＣＭＰエコーリクエストメッセージを受け取った端末装置２２１では、応答として、ＩＣＭＰエコーリプライメッセージを送信する。図８は、接続装置情報収集のために用いられるＩＣＭＰエコーリプライメッセージを格納するＭＡＣフレームフォーマットの一例を示す図である。図８において、４６１はＭＡＣヘッダ部であり、４６２はＩＰヘッダ部であり、４６３はＩＣＭＰメッセージ部であり、４６４は宛先ＭＡＣアドレス（ＭＡＣ＿１００）であり、４６５は送信元ＭＡＣアドレス（ＭＡＣ＿２２１）であり、４６６は宛先ＩＰアドレス（ＩＰ＿１００）であり、４６７は送信元ＩＰアドレス（ＩＰ＿２２１）である。ここでは、ＩＣＭＰエコーリクエストメッセージに対する応答として、送信元ＩＰアドレス４６７に自端末のＩＰアドレスを設定し、送信元ＭＡＣアドレス４６５に自装置のＭＡＣアドレスを設定することで生成したＩＣＭＰエコーリプライメッセージを送信する。このリプライメッセージは、ネットワーク接続装置１００の受信部４４２により受信され、学習部４４３に通知される。

【００４２】学習部４４３では、受け取ったリプライメッセージを精査し、送信元ＩＰアドレス４６７と送信元ＭＡＣアドレス４６５の組み合わせを学習し、その学習結果を接続装置情報として記録部１０７およびＡＲＰテーブル１０８に格納する。

【００４３】上記のように接続装置情報収集部１０２により接続装置情報を収集したネットワーク接続装置１００では、接続装置情報交換部１０３が、収集したＩＰアドレスをバックボーンネットワーク２１０上の通信パス２１１に送信する。この接続装置情報は、ネットワーク接続装置２００の接続装置情報交換部１０３に通知され、さらに、サブネット選択部１７４に転送される。

【００４４】ネットワーク接続装置２００のサブネット選択部１７４では、受け取った接続装置情報に基づいて、端末装置２２１と通信を行う可能性のある通信端末２２２を収容するサブネット２３０を選択し、さらに、当該接続装置情報をパケット生成部１７３に対して通知する。

【００４５】ネットワーク接続装置２００のパケット生成部１７３では、受け取った接続装置情報に基づいて、ＡＲＰリプライパケットを生成し、当該パケットをサブネット２３０に送信する。図９（ａ）は、ＡＲＰリプライパケットフォーマットの一例を示す図である。図９（ａ）において、４７０ａは宛先ＭＡＣアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）であり、４７０ｂは送信元ＭＡＣアドレス（ＭＡＣ＿２００）であり、４７０ｃはソースハードウェアアドレス（ＭＡＣ＿２００）であり、４７０ｄはソースプロトコルアドレス（ＩＰ＿２００）であり、４７０ｅはターゲットハードウェアアドレス（ＭＡＣ＿２００）であり、４７０ｆはターゲットプロトコルアドレス（ＩＰ＿２２１）である。ここでは、受け取った接続装置情報に含まれるＩＰアドレスをターゲットプロトコルアドレス４７０ｆに設定し、自ネットワーク接続装置２００がポート２９２で使用しているＩＰアドレスをソースプロトコルアドレス４７０ｄに設定し、自ネットワーク接続装置２００がポート２９２で使用しているＭＡＣアドレスをソースハードウェアアドレス４７０ｃとターゲットハードウェアアドレス４７０ｅと送信元ＭＡＣアドレス４７０ｂに設定し、ブロードキャストアドレスを宛先ＭＡＣアドレス４７０ａに設定し、パケット送信部１０４が、生成されたＡＲＰリプライパケットをサブネット２３０に送信する。このとき、ＡＲＰリプライパケットは、スイッチングハブ２３３を経由して端末装置２２２に通知される。

【００４６】ＡＲＰリプライパケットを受け取った端末装置２２２では、当該パケットに含まれるターゲットプロトコルアドレス４７０ｆとターゲットハードウェアアドレス４７０ｅに基づいて、ＡＲＰテーブル２２４を更新する。具体的にいうと、たとえば、図４（ａ）に示す

エントリを（ｂ）に示すエントリのように更新する。なお、上記のような端末装置２２２のＡＲＰテーブル更新動作は、ＩＥＴＦ（Internet Engineering Task Force），ＲＦＣ８２６に規定されたＡＲＰの一般的な動作である。また、更新動作完了後、端末装置２２２では、端末装置２２１に対してＩＰパケットを送信する場合、宛先ＭＡＣアドレスにＭＡＣアドレス４８７ｂを設定し、スイッチングハブ２３３では、受け取った当該ＩＰパケットを、ポート２８８を中継してネットワーク接続装置２００に対して送信することになる。

【００４７】また、ネットワーク接続装置２００では、ネットワーク接続装置１００の状態確認部１０１から送られてきた「現用ルータとして動作する旨の通知」を、状態確認部１０１が受け取ることで、サブネット２３０に障害が発生したことを認識する。そして、上記ネットワーク接続装置１００と同様の手順で、ネットワーク接続装置２００の接続装置情報収集部１０２が、端末装置２２２および２２７のＩＰアドレスを接続装置情報として収集し、接続装置情報交換部１０３が、当該接続装置情報をネットワーク接続装置１００に対して送信する。

【００４８】そして、接続装置情報を受け取ったネットワーク接続装置１００では、上記ネットワーク接続装置２００と同様の手順で、接続装置情報交換部１０３，サブネット選択部１７４，パケット生成部１７３，およびパケット送信部１０４を用いて、図９（ｂ）に示すＡＲＰリプライパケットおよび（ｃ）に示すＡＲＰリプライパケットを生成／送信し、端末装置２２１のＡＲＰテーブル２２３を更新する。具体的にいうと、たとえば、図３（ａ）に示すエントリを（ｂ）に示すエントリのように更新する。なお、図９（ｂ）において、４７１ａは宛先ＭＡＣアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）であり、４７１ｂは送信元ＭＡＣアドレス（ＭＡＣ＿１００）であり、４７１ｃはソースハードウェアアドレス（ＭＡＣ＿１００）であり、４７１ｄはソースプロトコルアドレス（ＩＰ＿１００）であり、４７１ｅはターゲットハードウェアアドレス（ＭＡＣ＿１００）であり、４７１ｆはターゲットプロトコルアドレス（ＩＰ＿２２２）であり、図９（ｃ）において、４７２ａは宛先ＭＡＣアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）であり、４７２ｂは送信元ＭＡＣアドレス（ＭＡＣ＿１００）であり、４７２ｃはソースハードウェアアドレス（ＭＡＣ＿１００）であり、４７２ｄはソースプロトコルアドレス（ＩＰ＿１００）であり、４７２ｅはターゲットハードウェアアドレス（ＭＡＣ＿１００）であり、４７２ｆはターゲットプロトコルアドレス（ＩＰ＿２２７）である。

【００４９】ただし、端末装置２２１と端末装置２２７が通信を行っておらず、端末装置２２１のＡＲＰテーブル２２３に端末装置２２７に相当するエントリがない場合には、端末装置２２１が図９（ｃ）に示すＡＲＰリプライパケットを受信した場合でも、ＡＲＰテーブル２２３の更新および追加は行われない。

【００５０】つぎに、端末装置２２１が端末装置２２２に対してＩＰパケットを送信する場合、ＭＡＣフレームの宛先ＭＡＣアドレスにはＭＡＣアドレス４８２ｂが設定されるため、スイッチングハブ２３１では、受け取ったＭＡＣフレームを、ポート２８１を中継してネットワーク接続装置１００に対して送信する。

【００５１】ＭＡＣフレームを受け取ったネットワーク接続装置１００では、比較部１０６が、ポート２９１で使用しているＩＰアドレスと当該ＭＡＣフレーム中の宛先ＩＰアドレス、およびポート２９１で使用しているＭＡＣアドレスと当該ＭＡＣフレーム中の宛先ＭＡＣアドレス、をそれぞれ比較する。そして、ＭＡＣアドレスが等しくかつＩＰアドレスが異なる場合には、中継部１０５が、ＭＡＣフレーム内のＩＰパケット部をネットワーク接続装置２００へ中継する。

【００５２】ＩＰパケットを受け取ったネットワーク接続装置２００では、当該ＩＰパケットをＭＡＣフレームに設定し、さらに、宛先ＩＰアドレスに基づいてＡＲＰテーブルを検索することで対応するＭＡＣアドレスを獲得し、その検索結果をＭＡＣフレームの宛先ＭＡＣアドレスに設定し、ここで生成されたＭＡＣフレームをポート２９２へ中継する。このとき、ＭＡＣフレームは、スイッチングハブ２３３を経由して端末装置２２２に通知される。なお、端末装置２２２が端末装置２２１に対してＩＰパケットを送信する場合も、ＩＰパケットは、上記と同様の手順でネットワーク接続装置２００およびネットワーク接続装置１００を中継され、端末装置２２１へ通知される。

【００５３】ただし、各ネットワーク接続装置が使用するＩＰアドレスとＭＡＣアドレスは、それぞれの装置で異なるアドレスを用いることとしてもよいし、ＶＲＲＰ等のプロトコルにより共通のアドレスを用いることとしてもよい。また、共通のアドレスを用いる場合で、かつ現用ルータとして動作するネットワーク接続装置が健全である間、待機ルータとして動作するネットワーク接続装置は、当該アドレスを用いて通信を行わない。

【００５４】このように、本実施の形態においては、故障等によりサブネット２３０内の各端末装置が分断された場合でも、バックボーンネットワーク２１０を経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる。また、上記と同様の場合に、サブネットに接続された端末装置が、自身に接続されたネットワーク接続装置にて生成したＡＲＰリプライパケットを受け取り、ＡＲＰの一般的な動作でＡＲＰテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更できる。また、本実施の形態においては、接続装置情報収集時に、ＩＣＭＰエコーリクエストメッセージをブロードキャストアドレスで

送信し、サブネットに接続されている各端末装置からのＩＣＭＰエコーリプライメッセージを同時に収集する構成としたため、効率良く接続装置情報を収集できる。

【００５５】実施の形態２．図１０は、本発明にかかるネットワーク接続装置の実施の形態２の構成を示す図である。図１０において、１００ａはネットワーク接続装置であり、１０１ａは状態確認部であり、１０３ａは接続装置情報交換部であり、１７４ａはサブネット選択部であり、１７５ａは転送パケット生成部である。また、図１１は、実施の形態２のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図１１において、２００ａは上記ネットワーク接続装置１００ａと同様の構成を持つネットワーク接続装置である。なお、前述の実施の形態１と同様の構成については、同一の符号を付してその説明を省略する。

【００５６】ここで、図１０および図１１を用いて上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、前述の実施の形態１と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置１００ａと２００ａが冗長な構成をとり、バックボーンネットワーク２１０とサブネット２３０とを接続する。また、ネットワーク接続装置１００ａが待機ルータとして、ネットワーク接続装置２００ａが現用ルータとして、それぞれ動作しているものとする。また、各ネットワーク接続装置は、仮想ＭＡＣアドレス（以後、ＭＡＣ＿Ｖと呼ぶ）とＩＰアドレス（以後、ＩＰ＿Ｖと呼ぶ）とを共有しているものとする。

【００５７】まず、ネットワーク接続装置１００ａでは、状態確認部１０１ａが、サブネット２３０を経由してネットワーク接続装置２００ａとの導通状態を監視する。この監視は、ＶＲＲＰメッセージ等を用い、現用ルータから送信される定期的なパケットを受信することで行う。また、ネットワーク接続装置１００ａの状態確認部１０１ａでは、バックボーンネットワーク２１０上の通信パス２１１を用い、ネットワーク接続装置２００ａの状態確認部１０１ａに対して定期的に自装置の動作状態を送信する。ここでいう動作状態とは、待機ルータとして動作しているか、または現用ルータとして動作しているか、を示す情報を意味する。

【００５８】たとえば、スイッチングハブ２３２が故障し、中継動作を行えなくなった場合、ネットワーク接続装置１００ａの状態確認部１０１ａでは、ＶＲＲＰメッセージの未到着により障害発生を認識し、接続装置情報収集部１０２に対して接続装置情報の収集を指示する。そして、通信パス２１１を経由してネットワーク接続装置２００ａに対して、自装置が、以後、現用ルータとして動作する旨を通知する。

【００５９】接続装置情報収集部１０２（図６参照）では、実施の形態１の場合と同様の手順で、送信元ＩＰアドレスと送信元ＭＡＣアドレスの組み合わせを学習し、その結果を接続装置情報として記録部１０７およびＡＲＰテーブル１０８に格納する。

【００６０】上記のように接続装置情報収集部１０２により接続装置情報を収集したネットワーク接続装置１００ａでは、転送パケット生成部１７５ａが、当該接続装置情報に基づいてＡＲＰリプライパケットを生成する。図１２（ａ）は、ＡＲＰリプライパケットフォーマットの一例を示す図である。図１２（ａ）において、４７５ａは宛先ＭＡＣアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）であり、４７５ｂは送信元ＭＡＣアドレス（ＭＡＣ＿Ｖ）であり、４７５ｃはソースハードウェアアドレス（ＭＡＣ＿Ｖ）であり、４７５ｄはソースプロトコルアドレス（ＩＰ＿Ｖ）であり、４７５ｅはターゲットハードウェアアドレス（ＭＡＣ＿Ｖ）であり、４７５ｆはターゲットプロトコルアドレス（ＩＰ＿２２１）である。ここでは、格納された接続装置情報に含まれるＩＰアドレスをターゲットプロトコルアドレス４７５ｆに設定し、仮想ＭＡＣアドレスであるＭＡＣ＿Ｖをターゲットハードウェアアドレス４７５ｅ，ソースハードウェアアドレス４７５ｃおよび送信元ＭＡＣアドレス４７５ｂにそれぞれ設定し、共有ＩＰアドレスであるＩＰ＿Ｖをソースプロトコルアドレス４７５ｄに設定し、ブロードキャストアドレスを宛先ＭＡＣアドレス４７５ａに設定することで、ＡＲＰリプライパケットを生成する。

【００６１】そして、接続装置情報交換部１０３ａでは、生成されたＡＲＰリプライパケットの形式で接続装置情報をバックボーンネットワーク２１０の通信パス２１１に送信する。このＡＲＰリプライパケット形式の接続装置情報（以降、単にＡＲＰリプライパケットと呼ぶ）は、ネットワーク接続装置２００ａの接続装置情報交換部１０３ａに通知され、さらに、サブネット選択部１７４ａに転送される。

【００６２】ネットワーク接続装置２００ａのサブネット選択部１７４ａでは、受け取ったＡＲＰリプライパケットに基づいて、端末装置２２１と通信を行う可能性のある通信端末２２２を収容するサブネット２３０を選択し、さらに、パケット送信部１０４では、当該ＡＲＰリプライパケットをサブネット２３０に送信する。このとき、ＡＲＰリプライパケットは、スイッチングハブ２３３を経由して端末装置２２２に通知される。

【００６３】ＡＲＰリプライパケットを受け取った端末装置２２２では、当該パケットに含まれるターゲットプロトコルアドレス４７５ｆとターゲットハードウェアアドレス４７５ｅに基づいて、ＡＲＰテーブル２２４を更新する。図１３は、更新後のエントリ（ＡＲＰテーブル２２４）の一例を示す図であり、４８８ａはＩＰアドレス（ＩＰ＿２２１）であり、４８８ｂはＭＡＣアドレス（ＭＡＣ＿Ｖ）である。

【００６４】また、ネットワーク接続装置２００ａで

は、ネットワーク接続装置１００ａの状態確認部１０１ａから送られてきた「現用ルータとして動作する旨の通知」を、状態確認部１０１ａが受け取ることで、サブネット２３０に障害が発生したことを認識する。そして、上記ネットワーク接続装置１００ａと同様の手順で、ネットワーク接続装置２００ａの接続装置情報収集部１０２が、端末装置２２２および２２７のＩＰアドレスを接続装置情報として収集し、転送パケット生成部１７５ａが、当該接続装置情報に基づいて図１２（ｂ）に示すＡＲＰリプライパケットおよび（ｃ）に示すＡＲＰリプライパケットを生成し、接続装置情報交換部１０３ａが、当該ＡＲＰリプライパケットの形式で接続装置情報をネットワーク接続装置１００ａに対して送信する。なお、図１２（ｂ）において、４７６ａは宛先ＭＡＣアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）であり、４７６ｂは送信元ＭＡＣアドレス（ＭＡＣ＿Ｖ）であり、４７６ｃはソースハードウェアアドレス（ＭＡＣ＿Ｖ）であり、４７６ｄはソースプロトコルアドレス（ＩＰ＿Ｖ）であり、４７６ｅはターゲットハードウェアアドレス（ＭＡＣ＿Ｖ）であり、４７６ｆはターゲットプロトコルアドレス（ＩＰ＿２２２）であり、図１２（ｃ）において、４７７ａは宛先ＭＡＣアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）であり、４７７ｂは送信元ＭＡＣアドレス（ＭＡＣ＿Ｖ）であり、４７７ｃはソースハードウェアアドレス（ＭＡＣ＿Ｖ）であり、４７７ｄはソースプロトコルアドレス（ＩＰ＿Ｖ）であり、４７７ｅはターゲットハードウェアアドレス（ＭＡＣ＿Ｖ）であり、４７７ｆはターゲットプロトコルアドレス（ＩＰ＿２２７）である。

【００６５】そして、ＡＲＰリプライパケットを受け取ったネットワーク接続装置１００ａでは、上記ネットワーク接続装置２００ａと同様の手順で、接続装置情報交換部１０３ａ，サブネット選択部１７４ａおよびパケット送信部１０４を用いて、当該ＡＲＰリプライパケットを送信し、端末装置２２１のＡＲＰテーブルを更新する。図１４は、更新後のエントリ（ＡＲＰテーブル２２３）の一例を示す図であり、４８３ａはＩＰアドレス（ＩＰ＿２２２）であり、４８３ｂはＭＡＣアドレス（ＭＡＣ＿Ｖ）である。

【００６６】このように、本実施の形態においては、故障等によりサブネット２３０内の各端末装置が分断された場合でも、各端末装置内のＡＲＰテーブルを書き換え、バックボーンネットワーク２１０を経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる。また、上記と同様の場合に、サブネットに接続された端末装置が、分断された端末装置に接続されたネットワーク接続装置にて生成したＡＲＰリプライパケットを受け取り、ＡＲＰの一般的な動作でＡＲＰテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更できる。

【００６７】実施の形態３．図１５は、本発明にかかるネットワーク接続装置の実施の形態３の構成を示す図である。図１５において、１００ｂはネットワーク接続装置であり、５０１ｂはＡＲＰパケット中継部であり、１０７ｂは接続装置情報を記録する記録部であり、２１０ｂはバックボーンネットワークであり、２１１ｂはネットワーク接続装置間を結ぶ通信パスであり、２３０ｂはサブネットであり、２９１ｂはサブネット２３０ｂに接続する入出力ポートであり、２９３ｂはバックボーンネットワーク２１０に接続する入出力ポートである。

【００６８】また、図１６は、上記ＡＲＰパケット中継部５０１ｂの構成を示す図である。図１６において、５１８はＡＲＰパケット受信部であり、５１９は検索部であり、５２０はリクエスト転送部であり、５２１はバックボーンパケット受信部であり、５２２はリプライパケット変換部であり、５２３はリプライパケット送信部であり、５２４はサブネット選択部であり、５２５はリクエストパケット変換部であり、５２６はリクエストパケット送信部であり、５２７はリプライ転送部である。

【００６９】また、図１７は、実施の形態３のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図１７において、２００ｂはネットワーク接続装置であり、２４０ｂ，２５０ｂはサブネットであり、５０４はサブネット分断箇所であり、２１１ｂはネットワーク接続装置間を結ぶ通信パスであり、５３１は端末装置２２１から送信されるＡＲＰリクエストパケットであり、５３２はネットワーク接続装置１００ｂから送信されるＡＲＰリクエストパケットであり、５３３はネットワーク接続装置２００ｂから送信されるＡＲＰリクエストパケットであり、５３４は端末装置２２２から送信されるＡＲＰリプライパケットであり、５３５はネットワーク接続装置２００ｂから送信されるＡＲＰリプライパケットであり、５３６はネットワーク接続装置１００ｂから送信されるＡＲＰリプライパケットでり、２９１ｂはネットワーク接続装置１００ｂのサブネット２３０ｂに接続する入出力ポートであり、２９２ｂはネットワーク接続装置２００ｂのサブネット２３０ｂに接続する入出力ポートである。なお、先に説明した実施の形態１と同様の構成については、同一の符号を付してその説明を省略する。

【００７０】ここで、図１５、図１６および図１７を用いて、上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、前述の実施の形態１と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置１００ａと１００ｂが冗長な構成をとり、バックボーンネットワーク２１０ｂとサブネット２３０ｂとを接続する。また、ネットワーク接続装置１００ｂが待機ルータとして、ネットワーク接続装置２００ｂが現用ルータとして、それぞれ動作しているものとし、仮想ＭＡＣアドレスとＩＰア

ドレスとを共有しているものとする。

【００７１】まず、ネットワーク接続装置１００ｂでは、状態確認部１０１が、実施の形態１と同様に、サブネット２３０ｂを経由してネットワーク接続装置２００ｂとの導通状態を監視する。そして、たとえば、サブネット２３０ｂがサブネット分断箇所５０４で分断され、図示のＡ部とＢ部のように分断された場合、ネットワーク接続装置１００ｂでは、状態確認部１０１が障害を検知し、先に説明した実施の形態１と同様の手順で、記録部１０７ｂおよびＡＲＰテーブル１０８に、ＩＰアドレスとＭＡＣアドレスの組み合わせを接続装置情報として記録する。その後、ネットワーク接続装置１００ｂは、現用ルータとしての動作を行う。

【００７２】たとえば、端末装置２２１が端末装置２２２と通信を行っていない場合、各端末装置のＡＲＰテーブルには互いの端末装置に相当するエントリが登録されておらず、各端末装置では、パケット送信部１０４から送信されたＡＲＰリプライパケットを受信した場合でも、ＡＲＰテーブルにエントリを追加しない。

【００７３】一方、端末装置２２１が新たに端末装置２２２と通信を行う場合、端末装置２２１では、端末装置２２２に対してＡＲＰリクエストパケット５３１を送信する。図１８は、ＡＲＰリクエストパケットおよびＡＲＰリプライパケットのフォーマットの一例を示す図であり、特に、図１８（ａ）は、ＡＲＰリクエストパケット５３１の一例を示す図である。図１８（ａ）において、５３１ａは宛先ＭＡＣアドレスであり、５３１ｂは送信元ＭＡＣアドレスであり、５３１ｃはソースハードウェアアドレスであり、５３１ｄはソースプロトコルアドレスであり、５３１ｅはターゲットハードウェアアドレスであり、５３１ｆはターゲットプロトコルアドレスである。ここでは、宛先ＭＡＣアドレス５３１ａにブロードキャストアドレス（ＭＡＣ＿ＢＣ）を設定し、送信元ＭＡＣアドレス５３１ｂおよびソースハードウェアアドレス５３１ｃに端末装置２２１のＭＡＣアドレス（ＭＡＣ＿２２１）を設定し、ソースプロトコルアドレス５３１ｄに端末装置２２１のＩＰアドレス（ＩＰ＿２２１）を設定し、ターゲットプロトコルアドレス５３１ｆに端末装置２２２のＩＰアドレス（ＩＰ＿２２２）を設定する。

【００７４】ＡＲＰリクエストパケット５３１を受け取ったネットワーク接続装置１００ｂのＡＰＲパケット中継部５０１ｂでは、ＡＲＰパケット受信部５１８が、当該ＡＲＰリクエストパケット５３１中のターゲットプロトコルアドレス５３１ｆを抽出する。そして、そのＩＰアドレスがポート２９１ｂで使用しているＩＰアドレスでなければ、検索部５１９が、記録部１０７ｂに記録されたエントリに、ターゲットプロトコルアドレス５３１ｆに該当するエントリがあるかどうかを検索する。なお、端末装置２２２がネットワーク接続装置２００ｂ側のＢ部に接続しているため、ここでの検索結果は該当エントリ無しとなる。

【００７５】該当エントリが無い場合、検索部５１９では、リクエスト転送部５２０にＡＲＰリクエストパケット５３１を転送し、リクエスト転送部５２０では、受け取ったＡＲＰリクエストパケット５３１に相当するＡＲＰリクエストパケット５３２を、バックボーンネットワーク２１０ｂ上に設定された通信パス２１１ｂを介してネットワーク接続装置２００ｂに対して送信する。図１８（ｂ）は、ＡＲＰリクエストパケット５３２の一例を示す図である。図１８（ｂ）において、５３２ａは宛先ＭＡＣアドレスであり、５３２ｂは送信元ＭＡＣアドレスであり、５３２ｃはソースハードウェアアドレスであり、５３２ｄはソースプロトコルアドレスであり、５３２ｅはターゲットハードウェアアドレスであり、５３２ｆはターゲットプロトコルアドレスである。ここでは、宛先ＭＡＣアドレス５３２ａにブロードキャストアドレス（ＭＡＣ＿ＢＣ）を設定し、送信元ＭＡＣアドレス５３２ｂおよびソースハードウェアアドレス５３２ｃに端末装置２２１のＭＡＣアドレス（ＭＡＣ＿２２１）を設定し、ソースプロトコルアドレス５３２ｄに端末装置２２１のＩＰアドレス（ＩＰ＿２２１）を設定し、ターゲットプロトコルアドレス５３２ｆに端末装置２２２のＩＰアドレス（ＩＰ＿２２２）を設定する。

【００７６】ＡＲＰリクエストパケット５３２を受け取ったネットワーク接続装置２００ｂでは、バックボーンパケット受信部５２１が、サブネット選択部５２４に対して当該ＡＲＰリクエストパケット５３２を通知する。サブネット選択部５２４では、受け取ったＡＲＰリクエストパケット５３２からターゲットプロトコルアドレス５３２ｆを抽出し、ネットワーク接続装置２００ｂの収容するサブネットのなかから当該アドレスを含むサブネット２３０ｂを選択する。そして、リクエストパケット変換部５２５に対してＡＲＰリクエストパケット５３２を通知する。

【００７７】ネットワーク接続装置２００ｂのリクエストパケット変換部５２５では、ＡＲＰリクエストパケット５３２の送信元ＭＡＣアドレス５３２ｂとソースハードウェアアドレス５３２ｃとを仮想ＭＡＣアドレス（ＭＡＣ＿Ｖ）に書き換える。そして、リクエストパケット送信部５２６では、書き換え後のＡＲＰリクエストパケット５３３をサブネット２３０ｂに接続するポート２９２ｂから送信する。図１８（ｃ）は、ＡＲＰリクエストパケット５３３の一例を示す図である。図１８（ｃ）において、５３３ａは宛先ＭＡＣアドレスであり、５３３ｂは送信元ＭＡＣアドレスであり、５３３ｃはソースハードウェアアドレスであり、５３３ｄはソースプロトコルアドレスであり、５３３ｅはターゲットハードウェアアドレスであり、５３３ｆはターゲットプロトコルアドレスである。ここでは、宛先ＭＡＣアドレス５３３ａに

ブロードキャストアドレス（ＭＡＣ＿ＢＣ）を設定し、送信元ＭＡＣアドレス５３３ｂおよびソースハードウェアアドレス５３３ｃに仮想ＭＡＣアドレス（ＭＡＣ＿Ｖ）を設定し、ソースプロトコルアドレス５３３ｄに端末装置２２１のＩＰアドレス（ＩＰ＿２２１）を設定し、ターゲットプロトコルアドレス５３３ｆに端末装置２２２のＩＰアドレス（ＩＰ＿２２２）を設定する。

【００７８】ＡＲＰリクエストパケット５３３を受け取った端末装置２２２では、ソースプロトコルアドレス５３３ｄに格納された端末装置２２１のＩＰアドレスと、ソースハードウェアアドレス５３３ｃに格納された仮想ＭＡＣアドレスと、を学習し、その学習結果をＡＲＰテーブルに登録する。そして、受け取ったパケットに対する応答として、ＡＲＰリプライパケット５３４を送信する。図１８（ｄ）は、ＡＲＰリプライパケット５３４の一例を示す図である。図１８（ｄ）において、５３４ａは宛先ＭＡＣアドレスであり、５３４ｂは送信元ＭＡＣアドレスであり、５３４ｃはソースハードウェアアドレスであり、５３４ｄはソースプロトコルアドレスであり、５３４ｅはターゲットハードウェアアドレスであり、５３４ｆはターゲットプロトコルアドレスである。ここでは、宛先ＭＡＣアドレス５３４ａおよびターゲットハードウェアアドレス５３４ｅに仮想ＭＡアドレス（ＭＡＣ＿Ｖ）を設定し、送信元ＭＡＣアドレス５３４ｂおよびソースハードウェアアドレス５３４ｃに端末装置２２２のＭＡＣアドレス（ＭＡＣ＿２２２）を設定し、ソースプロトコルアドレス５３４ｄに端末装置２２２のＩＰアドレス（ＩＰ＿２２２）を設定し、ターゲットプロトコルアドレス５３４ｆに端末装置２２１のＩＰアドレス（ＩＰ＿２２１）を設定する。

【００７９】ＡＲＰリプライパケット５３４を受け取ったネットワーク接続装置２００ｂのＡＰＲパケット中継部５０１ｂでは、ＡＲＰパケット受信部５１８が、当該ＡＲＰリプライパケット５３４中のターゲットプロトコルアドレス５３４ｆを抽出する。そして、そのＩＰアドレスがポート２９２ｂで使用しているＩＰアドレスでなければ、リプライ転送部５２７に対してＡＲＰリプライパケット５３４を転送する。リプライ転送部５２７では、受け取ったＡＲＰリプライパケット５３４に相当するＡＲＰリプライパケット５３５を、バックボーンネットワーク２１０ｂ上に設定された通信パス２１１ｂを介してネットワーク接続装置１００ｂに対して送信する。図１８（ｅ）は、ＡＲＰリプライパケット５３５の一例を示す図である。図１８（ｅ）において、５３５ａは宛先ＭＡＣアドレスであり、５３５ｂは送信元ＭＡＣアドレスであり、５３５ｃはソースハードウェアアドレスであり、５３５ｄはソースプロトコルアドレスであり、５３５ｅはターゲットハードウェアアドレスであり、５３５ｆはターゲットプロトコルアドレスである。ここでは、宛先ＭＡＣアドレス５３５ａおよびターゲットハードウェアアドレス５３５ｅに仮想ＭＡＣアドレス（ＭＡＣ＿Ｖ）を設定し、送信元ＭＡＣアドレス５３５ｂおよびソースハードウェアアドレス５３５ｃに端末装置２２２のＭＡＣアドレス（ＭＡＣ＿２２２）を設定し、ソースプロトコルアドレス５３５ｄに端末装置２２２のＩＰアドレス（ＩＰ＿２２２）を設定し、ターゲットプロトコルアドレス５３５ｆに端末装置２２１のＩＰアドレス（ＩＰ＿２２１）を設定する。

【００８０】ＡＲＰリプライパケット５３５を受け取ったネットワーク接続装置１００ｂでは、バックボーンパケット受信部５２１が、サブネット選択部５２４に対して当該ＡＲＰリプライパケット５３５を通知する。サブネット選択部５２４では、受け取ったＡＲＰリプライパケット５３５からターゲットプロトコルアドレス５３５ｆを抽出し、ネットワーク接続装置１００ｂの収容するサブネットのなかから当該アドレスを含むサブネット２３０ｂを選択する。そして、リプライパケット変換部５２２に対してＡＲＰリプライパケット５３５を通知する。

【００８１】ネットワーク接続装置１００ｂのリプライパケット変換部５２２では、ＡＲＰリプライパケット５３５のターゲットプロトコルアドレス５３５ｆを抽出する。その後、検索部５１９が、当該ターゲットプロトコルアドレス５３５ｆに対応するＭＡＣアドレスを獲得し、その獲得結果に基づいて宛先ＭＡＣアドレス５３５ａおよびターゲットハードウェアアドレス５３５ｅを書き換える。また、リプライパケット変換部５２２では、送信元ＭＡＣアドレス５３５ｂとソースハードウェアアドレス５３５ｃとを、ポート２９１ｂで使用している仮想ＭＡＣアドレスＭＡＣ＿Ｖに書き換える。そして、リプライパケット送信部５２３では、書き換え後のＡＲＰリプライパケット５３６をサブネット２３０ｂに接続するポート２９１ｂから送信する。図１８（ｆ）は、ＡＲＰリプライパケット５３６の一例を示す図である。図１８（ｆ）において、５３６ａは宛先ＭＡＣアドレスであり、５３６ｂは送信元ＭＡＣアドレスであり、５３６ｃはソースハードウェアアドレスであり、５３６ｄはソースプロトコルアドレスであり、５３６ｅはターゲットハードウェアアドレスであり、５３６ｆはターゲットプロトコルアドレスである。ここでは、宛先ＭＡＣアドレス５３６ａおよびターゲットハードウェアアドレス５３６ｅに端末装置２２１のＭＡＣアドレス（ＭＡＣ＿２２１）を設定し、送信元ＭＡＣアドレス５３６ｂおよびソースハードウェアアドレス５３６ｃに仮想ＭＡＣアドレス（ＭＡＣ＿Ｖ）を設定し、ソースプロトコルアドレス５３６ｄに端末装置２２２のＩＰアドレス（ＩＰ＿２２２）を設定し、ターゲットプロトコルアドレス５３６ｆに端末装置２２１のＩＰアドレス（ＩＰ＿２２１）を設定する。

【００８２】ＡＲＰリプライパケット５３６を受け取っ

た端末装置２２１では、端末装置２２２のＩＰアドレスに対応するＭＡＣアドレスとして、ソースハードウェアアドレス５３６ｃに格納された仮想ＭＡＣアドレスを学習し、ＡＲＰテーブルに登録する。

【００８３】以降、端末装置２２１から端末装置２２２へのパケット送信は、仮想ＭＡＣアドレス宛に行われ、実施の形態１と同様の手順で、ネットワーク接続装置１００ｂおよび２００ｂに中継される。また、端末装置２２２から端末装置２２１へのパケット送信についても、ＡＲＰテーブルに仮想ＭＡＣアドレスが登録されているため、仮想ＭＡＣアドレス宛に行われる。これにより、相互の通信が可能となる。

【００８４】このように、本実施の形態においては、サブネット２３０ｂが分断された場合でも、各ネットワーク接続装置がバックボーンネットワークを経由してＡＲＰパケットを中継する構成としたため、もともとエントリが登録されていない分断された端末装置間においても新たに通信を行うことができる。また、本実施の形態においては、ブロードキャストアドレス宛に送信されたＩＣＭＰリクエストメッセージに対して応答しないように設定された端末装置についても、バックボーンネットワークを介してアドレス解決を行うことができる。また、サブネットに接続された端末装置においては、ＡＲＰリクエストパケットおよびＡＲＰレスポンスパケットを送受信することで、ＡＲＰテーブルを更新するため、特別な処理を追加することなくバックボーンネットワークを用いた通信が可能となる。

【００８５】実施の形態４．図１９は、本発明にかかるネットワーク接続装置の実施の形態４の構成を示す図である。図１９において、１００ｃはネットワーク接続装置であり、１０１ｃは状態確認部であり、１０３ｃは接続装置情報交換部であり、１０４ｃはパケット送信部であり、１０７ｃは記録部であり、１７４ｃはサブネット選択部であり、１７５ｃは転送パケット生成部であり、６４１ｃは回復パケット生成部である。なお、上記ネットワーク接続装置１００ｃ，状態確認部１０１ｃ，接続装置情報交換部１０３ｃ，パケット送信部１０４ｃ，記録部１０７ｃ，サブネット選択部１７４ｃ，転送パケット生成部１７５ｃについては、本実施の形態における特徴的な機能以外に、それぞれ先に説明した実施の形態１または２における状態確認部，接続装置情報交換部，パケット送信部，記録部，サブネット選択部，転送パケット生成部と同様の機能を含むことを前提とする。

【００８６】また、図２０は、実施の形態４のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図２０において、２００ｃはネットワーク接続装置である。なお、先に説明した実施の形態１または２と同様の構成については、同一の符号を付してその説明を省略する。

【００８７】ここで、図１９および図２０を用いて上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、先に説明した実施の形態１または２と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置１００ｃと２００ｃが冗長な構成をとり、バックボーンネットワーク２１０とサブネット２３０とを接続する。また、本実施の形態では、ネットワーク接続装置１００ｃが待機ルータとして、ネットワーク接続装置２００ｃが現用ルータとして、それぞれ動作し、さらに、スイッチングハブ２３２が故障した状態を前提とする。すなわち、実施の形態２と同様の手順で、端末装置２２１のＡＲＰテーブル２２３に図２１（ａ）に示すエントリが登録され、端末装置２２２のＡＲＰテーブル２２４に図２２（ａ）に示すエントリが登録され、ネットワーク接続装置１００ｃの記録部１０７ｃに図２３に示すエントリが登録され、ネットワーク接続装置２００ｃの記録部１０７ｃに図２４に示すエントリが登録された状態を前提とする。

【００８８】ただし、図２１は、端末装置２２１のＡＲＰテーブルに記録されるエントリの一例を示す図であり、図２１（ａ）に示す障害発生時のエントリにおいて、６２５ａはＩＰアドレスであり、６２５ｂはＭＡＣアドレスであり、図２１（ｂ）に示す正常時のエントリにおいて、６２６ａはＩＰアドレスであり、６２６ｂはＭＡＣアドレスである。また、図２２は、端末装置２２２のＡＲＰテーブルに記録されるエントリの一例を示す図であり、図２２（ａ）に示す障害発生時のエントリにおいて、６２７ａはＩＰアドレスであり、６２７ｂはＭＡＣアドレスであり、図２２（ｂ）に示す正常時のエントリにおいて、６２８ａはＩＰアドレスであり、６２８ｂはＭＡＣアドレスである。また、図２３は、ネットワーク接続装置１００ｃの記録部１０７ｃに記録されるエントリの例であり、図２３において、６５２ａはＩＰアドレスであり、６５２ｂはＭＡＣアドレスである。また、図２４は、ネットワーク接続装置２００ｃの記録部１０７ｃに記録されるエントリの例であり、図２４において、６５３ａはＩＰアドレスであり、６５３ｂはＭＡＣアドレスである。

【００８９】この状態で、スイッチングハブ２３２が回復すると、ネットワーク接続装置１００ｃの状態確認部１０１ｃでは、ｐｉｎｇの導通やネットワーク接続装置２００ｃからのＶＲＲＰメッセージ受信などによりサブネット２３０の障害回復を検出し、通信パス２１１を経由してネットワーク接続装置２００ｃに対して自装置が待機ルータとして動作する旨を通知する。

【００９０】上記通知を受け取ったネットワーク接続装置２００ｃでは、状態確認部１０１ｃが、その旨を回復パケット生成部６４１ｃに通知する。回復パケット生成部６４１ｃでは、自装置の記録部１０７ｃを参照し、エントリに基づいてＡＲＰリプライパケットを生成する。図２５は、ＡＲＰリプライパケットフォーマットの一例

を示す図である。図２５（ａ）に示すネットワーク接続装置１００ｃのＡＲＰリプライパケットおいて、６６０ａは宛先ＭＡＣアドレスであり、６６０ｂは送信元ＭＡＣアドレスであり、６６０ｃはソースハードウェアアドレスであり、６６０ｄはソースプロトコルアドレスであり、６６０ｅはターゲットハードウェアアドレスであり、６６０ｆはターゲットプロトコルアドレスである。図２５（ｂ）に示すネットワーク接続装置２００ｃのＡＲＰリプライパケットおいて、６６１ａは宛先ＭＡＣアドレスであり、６６１ｂは送信元ＭＡＣアドレスであり、６６１ｃはソースハードウェアアドレスであり、６６１ｄはソースプロトコルアドレスであり、６６１ｅはターゲットハードウェアアドレスであり、６６１ｆはターゲットプロトコルアドレスである。

【００９１】ここでは、図２５（ｂ）に示すように、ターゲットプロトコルアドレス６６１ｆにＩＰアドレス６５３ａ（ＩＰ＿２２２）を設定し、ターゲットハードウェアアドレス６６１ｅにＭＡＣアドレス６５３ｂ（ＭＡＣ＿２２２）を設定し、ソースプロトコルアドレス６６１ｄにポート２９２で使用しているＩＰアドレス（ＩＰ＿Ｖ）を設定し、ソースハードウェアアドレス６６１ｃと送信元ＭＡＣアドレス６６１ｂにポート２９２で使用している仮想ＭＡＣアドレス（ＭＡＣ＿Ｖ）を設定し、宛先ＭＡＣアドレス６６１ａにブロードキャストアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）を設定する。

【００９２】ネットワーク接続装置２００ｃのパケット送信部１０４ｃでは、上記のように生成したＡＲＰリプライパケットをポート２９２から送信する。

【００９３】このとき、ＡＲＰリプライパケットを受け取った端末装置２２１では、当該パケットに含まれるターゲットハードウェアアドレス６６１ｅとターゲットプロトコルアドレス６６１ｆに基づいて、図２１（ａ）に示すＡＲＰテーブルのエントリを図２１（ｂ）のように更新する。

【００９４】一方、ネットワーク接続装置１００ｃは、待機ルータとなるのでサブネット２３０上で仮想アドレスを使用した通信ができない。そこで、ネットワーク接続装置１００ｃの保有する情報をネットワーク接続装置２００ｃに転送し、ネットワーク接続装置２００ｃからＡＲＰリプライパケットを送信する。具体的にいうと、ネットワーク接続装置１００ｃでは、状態確認部１０１ｃがサブネット２３０の障害回復を検出すると、転送パケット生成部１７５ｃが、記録部１０７ｃに記録されているエントリに基づいてＡＲＰリプライパケットを生成する。ここでは、図２５（ａ）に示すように、ターゲットプロトコルアドレス６６０ｆにＩＰアドレス６５２ａ（ＩＰ＿２２１）を設定し、ターゲットハードウェアアドレス６６０ｅにＭＡＣアドレス６５２ｂ（ＭＡＣ＿２２１）を設定し、ソースプロトコルアドレス６６０ｄに仮想ＩＰアドレス（ＩＰ＿Ｖ）を設定し、ソースハードウェアアドレス６６０ｃと送信元ＭＡＣアドレス６６０ｂに仮想ＭＡＣアドレス（ＭＡＣ＿Ｖ）を設定し、宛先ＭＡＣアドレス６６０ａにブロードキャストアドレス（ＭＡＣ＿Ｂｒｏａｄｃａｓｔ）を設定する。

【００９５】ネットワーク接続装置１００ｃの接続装置情報交換部１０３ｃでは、上記のように生成したＡＲＰリプライパケットの形式で接続装置情報をネットワーク接続装置２００ｃに対して送信する。

【００９６】上記接続装置情報、すなわち、ＡＲＰリプライパケットを受け取ったネットワーク接続装置２００ｃでは、サブネット選択部１７４ｃが、バックボーンネットワーク２１０からの受信でありかつ送信元ＭＡＣアドレスがポート２９２の仮想ＭＡＣアドレスであることから、宛先がサブネット２３０であることを識別する。そして、パケット送信部１０４ｃでは、当該パケットをポート２９２から送信する。

【００９７】ＡＲＰリプライパケットを受け取った端末装置２２２では、当該パケットに含まれるターゲットハードウェアアドレス６６０ｅとターゲットプロトコルアドレス６６０ｆに基づいて、図２２（ａ）に示すＡＲＰテーブルのエントリを図２２（ｂ）のように更新する。

【００９８】このように、本実施の形態においては、サブネット２３０の障害が回復した場合に、各端末装置が、障害により更新されたＡＲＰテーブルのエントリをもとの状態（正常時）に書き換える構成としたため、以降、互いのＭＡＣアドレスの直接指定により、端末装置間の通信を継続することができる。また、本実施の形態においては、サブネット２３０に接続された各端末装置が、ＡＲＰの一般的な動作によりＡＲＰテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を選択できる。

【００９９】実施の形態５．図２６は、本発明にかかるネットワーク接続装置の実施の形態５の構成を示す図である。図２６において、１００ｄはネットワーク接続装置であり、１０３ｄは接続装置情報交換部であり、１７３ｄはパケット生成部であり、１７４ｄはサブネット選択部である。

【０１００】また、図２７は、実施の形態５のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。図２７において、２００ｄはネットワーク接続装置である。なお、先に説明した実施の形態１～４と同様の構成については、同一の符号を付してその説明を省略する。

【０１０１】ここで、図２６および図２７を用いて上記ネットワーク接続装置の動作を説明する。なお、本実施の形態では、先に説明した実施の形態１～４と異なる動作についてのみ説明する。また、本実施の形態のネットワークシステムは、ネットワーク接続装置１００ｄと２００ｄが冗長な構成をとり、バックボーンネットワーク２１０とサブネット２３０とを接続する。また、本実施

の形態では、ネットワーク接続装置１００ｄが待機ルータとして、ネットワーク接続装置２００ｄが現用ルータとして、それぞれ動作し、さらに、スイッチングハブ２３２が故障した状態を前提とする。すなわち、実施の形態２と同様の手順で、端末装置２２１のＡＲＰテーブル２２３に図２１（ａ）に示すエントリが登録され、端末装置２２２のＡＲＰテーブル２２４に図２２（ａ）に示すエントリが登録され、ネットワーク接続装置１００ｃの記録部１０７ｃに図２３に示すエントリが登録され、ネットワーク接続装置２００ｃの記録部１０７ｃに図２４に示すエントリが登録された状態を前提とする。

【０１０２】この状態で、スイッチングハブ２３２が回復すると、ネットワーク接続装置１００ｄでは、前述の実施の形態４と同様に、図２５に示すＡＲＰリプライパケットを生成し、当該ＡＲＰリプライパケットをポート２９２から送信する。そして、端末装置２２１では、図２１（ａ）に示すＡＲＰテーブルのエントリを図２１（ｂ）のように更新する。

【０１０３】一方、ネットワーク接続装置１００ｄは、待機ルータとなるのでサブネット２３０上で仮想アドレスを使用した通信ができない。そこで、ネットワーク接続装置２００ｄでは、状態確認部１０１ｃがサブネット２３０の障害回復を検出すると、接続装置情報交換部１０３ｄが、記録部１０７ｃに記録されているエントリに基づいて接続装置情報を生成し、当該接続装置情報をネットワーク接続装置２００ｄに対して送信する。すなわち、図２３のエントリの内容を参照し、ＩＰアドレス６５２ａとＭＡＣアドレス６５２ｂを接続装置情報として送信する。

【０１０４】接続装置情報を受け取ったネットワーク接続装置２００ｄの接続装置情報交換部１０３ｄでは、当該情報に含まれるＩＰアドレスをサブネット選択部１７４ｄに転送し、サブネット選択部１７４ｄでは、ネットワーク接続装置１００ｄが収容するサブネットの中から、受け取ったＩＰアドレスが含まれるサブネット２３０を選択し、パケット生成部１７３ｄに通知する。

【０１０５】ネットワーク接続装置２００ｄのパケット生成部１７３ｄでは、図２５（ａ）に示すように、ＡＲＰリプライパケットを生成する。そして、パケット送信部１０４ｃでは、受け取ったＡＲＰリプライパケットをポート２９２から送信する。

【０１０６】ＡＲＰリプライパケットを受け取った端末装置２２２では、当該パケットに含まれるターゲットハードウェアアドレス６６０ｅとターゲットプロトコルアドレス６６０ｆに基づいて、図２２（ａ）に示すＡＲＰテーブルのエントリを図２２（ｂ）のように更新する。

【０１０７】このように、本実施の形態においては、接続装置情報として、ＩＰアドレスとＭＡＣアドレスの組み合わせのみを送る構成としたため、前述の実施の形態４と同様の効果が得られるとともに、さらに、ＡＲＰパケットを送信する場合と比較してバックボーンネットワークのトラヒック量を大幅に削減することができる。また、本実施の形態においては、自装置の記録部に記録されたエントリに基づいてＡＲＰリプライパケットを生成する場合と、他のネットワーク接続装置から得た接続装置情報に基づいてＡＲＰリプライパケットを生成する場合で、処理が同じであるため、実装を簡単にすることができる。

【０１０８】

【発明の効果】以上、説明したとおり、本発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。また、上記と同様の場合に、サブネットに接続された端末装置が、自身に接続されたネットワーク接続装置にて生成したＡＲＰリプライパケットを受け取り、ＡＲＰの一般的な動作でＡＲＰテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更することができる、という効果を奏する。

【０１０９】つぎの発明によれば、サブネットが分断された場合でも、各ネットワーク接続装置がバックボーンネットワークを経由してＡＲＰパケットを中継する構成としたため、もともとエントリが登録されていない分断された端末装置間においても新たに通信を行うことができる、という効果を奏する。また、ブロードキャストアドレス宛に送信されたＩＣＭＰリクエストメッセージに対して応答しないように設定された端末装置についても、バックボーンネットワークを介してアドレス解決を行うことができる、という効果を奏する。また、サブネットに接続された端末装置においては、ＡＲＰリクエストパケットおよびＡＲＰレスポンスパケットを送受信することで、ＡＲＰテーブルを更新するため、特別な処理を追加することなくバックボーンネットワークを用いた通信が可能となる、という効果を奏する。

【０１１０】つぎの発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、各端末装置内のＡＲＰテーブルを書き換え、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。また、上記と同様の場合に、サブネットに接続された端末装置が、分断された端末装置に接続されたネットワーク接続装置にて生成したＡＲＰリプライパケットを受け取り、ＡＲＰの一般的な動作でＡＲＰテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を変更できる、という効果を奏する。

【０１１１】つぎの発明によれば、サブネットの障害が回復した場合に、各端末装置が、障害により更新されたＡＲＰテーブルのエントリをもとの状態（正常時）に書

き換える構成としたため、以降、互いのＭＡＣアドレスの直接指定により、端末装置間の通信を継続することができる、という効果を奏する。また、サブネットに接続された各端末装置が、ＡＲＰの一般的な動作によりＡＲＰテーブルを書き換える構成としたため、特別な処理を追加することなく通信経路を選択できる、という効果を奏する。

【０１１２】つぎの発明によれば、接続装置情報として、ＩＰアドレスとＭＡＣアドレスの組み合わせのみを送る構成としたため、さらに、ＡＲＰパケットを送信する場合と比較してバックボーンネットワークのトラヒック量を大幅に削減することができる、という効果を奏する。また、自装置で収集した接続装置情報に基づいてＡＲＰリプライパケットを生成する場合と、他のネットワーク接続装置から得た接続装置情報に基づいてＡＲＰリプライパケットを生成する場合で、処理が同じであるため、実装を簡単にすることができる、という効果を奏する。

【０１１３】つぎの発明によれば、接続装置情報収集時に、ＩＣＭＰエコーリクエストメッセージをブロードキャストアドレスで送信し、サブネットに接続されている各端末装置からのＩＣＭＰエコーリプライメッセージを同時に収集する構成としたため、効率良く接続装置情報を収集できる、という効果を奏する。

【０１１４】つぎの発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。

【０１１５】つぎの発明によれば、サブネットが分断された場合でも、各ネットワーク接続装置がバックボーンネットワークを経由してＡＲＰパケットを中継する構成としたため、もともとエントリが登録されていない分断された端末装置間においても新たに通信を行うことができる、という効果を奏する。また、ブロードキャストアドレス宛に送信されたＩＣＭＰリクエストメッセージに対して応答しないように設定された端末装置についても、バックボーンネットワークを介してアドレス解決を行うことができる、という効果を奏する。

【０１１６】つぎの発明によれば、故障等によりサブネット内の各端末装置が分断された場合でも、各端末装置内のＡＲＰテーブルを書き換え、バックボーンネットワークを経由して通信を行う構成としたため、分散された端末装置間の通信を継続させることができる、という効果を奏する。

【０１１７】つぎの発明によれば、サブネットの障害が回復した場合に、各端末装置が障害により更新されたＡＲＰテーブルのエントリをもとの状態（正常時）に書き換えるように制御する構成としたため、以降、互いのＭＡＣアドレスの直接指定により、端末装置間の通信を継続することができる、という効果を奏する。

【０１１８】つぎの発明によれば、接続装置情報として、ＩＰアドレスとＭＡＣアドレスの組み合わせのみを送る構成としたため、さらに、ＡＲＰパケットを送信する場合と比較してバックボーンネットワークのトラヒック量を大幅に削減することができる、という効果を奏する。また、自装置で収集した接続装置情報に基づいてＡＲＰリプライパケットを生成する場合と、他のネットワーク接続装置から得た接続装置情報に基づいてＡＲＰリプライパケットを生成する場合で、処理が同じであるため、実装を簡単にすることができる、という効果を奏する。

【０１１９】つぎの発明によれば、接続装置情報収集時に、ＩＣＭＰエコーリクエストメッセージをブロードキャストアドレスで送信し、サブネットに接続されている各端末装置からのＩＣＭＰエコーリプライメッセージを同時に収集する構成としたため、効率良く接続装置情報を収集できる、という効果を奏する。

【図面の簡単な説明】

【図１】　本発明にかかるネットワーク接続装置の実施の形態１の構成を示す図である。

【図２】　実施の形態１のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。

【図３】　端末装置２２１のＡＲＰテーブルに記録されるエントリの一例を示す図である。

【図４】　端末装置２２２のＡＲＰテーブルに記録されるエントリの一例を示す図である。

【図５】　端末装置２２１から端末装置２２２へのＭＡＣフレームを示す図である。

【図６】　接続装置情報収集部１０２の構成を示す図である。

【図７】　ＩＣＭＰエコーリクエストメッセージを格納するＭＡＣフレームフォーマットの一例を示す図である。

【図８】　ＩＣＭＰエコーリプライメッセージを格納するＭＡＣフレームフォーマットの一例を示す図である。

【図９】　ＡＲＰリプライパケットフォーマットの一例を示す図である。

【図１０】　本発明にかかるネットワーク接続装置の実施の形態２の構成を示す図である。

【図１１】　実施の形態２のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。

【図１２】　ＡＲＰリプライパケットフォーマットの一例を示す図である。

【図１３】　更新後のエントリ（ＡＲＰテーブル２２４）の一例を示す図である。

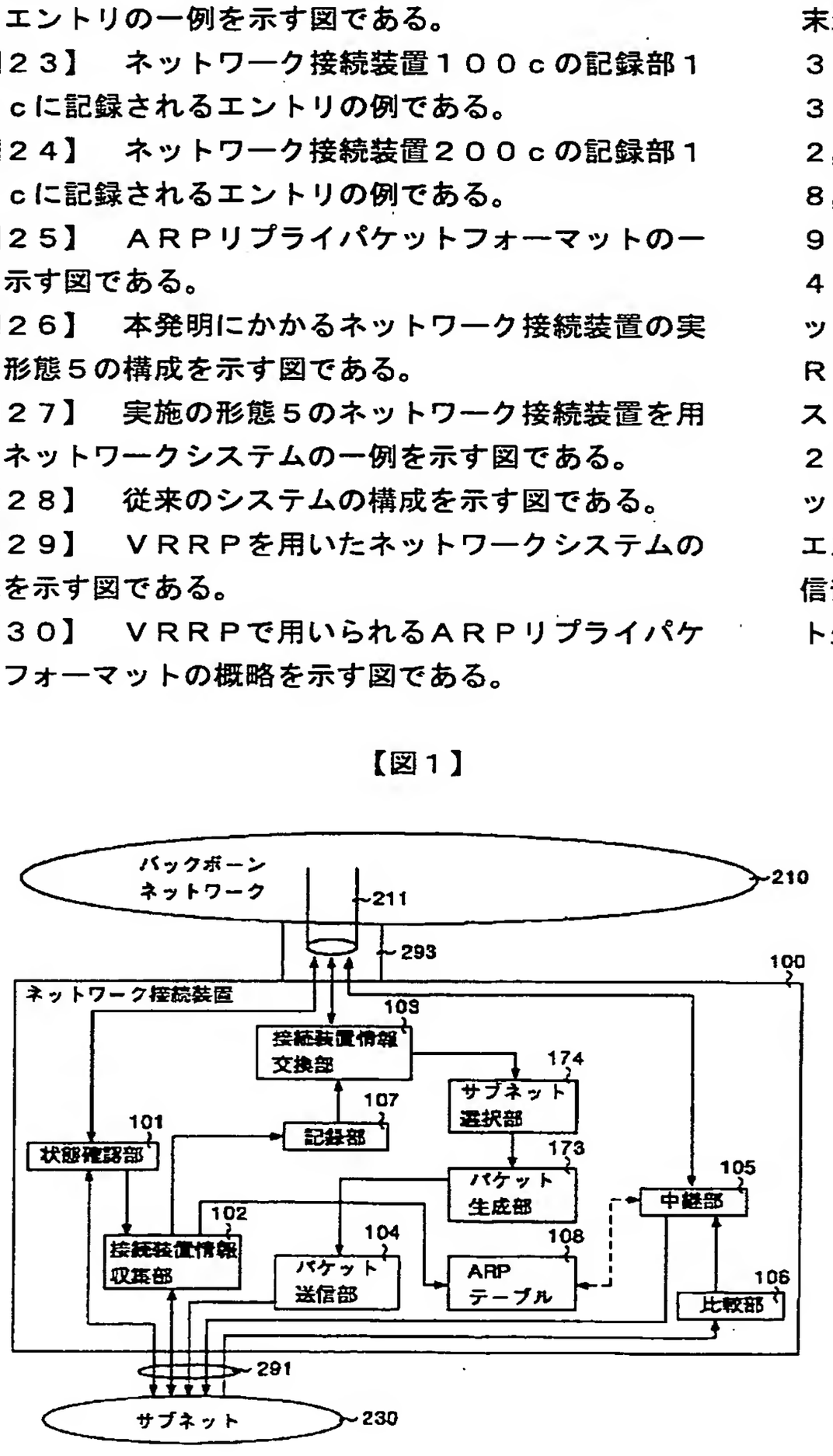
【図１４】　更新後のエントリ（ＡＲＰテーブル２２３）の一例を示す図である。

【図１５】　本発明にかかるネットワーク接続装置の実施の形態３の構成を示す図である。

【図１６】　ＡＲＰパケット中継部５０１ｂの構成を示す図である。
【図１７】　実施の形態３のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。
【図１８】　ＡＲＰリクエストパケットおよびＡＲＰリプライパケットのフォーマットの一例を示す図である。
【図１９】　本発明にかかるネットワーク接続装置の実施の形態４の構成を示す図である。
【図２０】　実施の形態４のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。
【図２１】　端末装置２２１のＡＲＰテーブルに記録されるエントリの一例を示す図である。
【図２２】　端末装置２２２のＡＲＰテーブルに記録されるエントリの一例を示す図である。
【図２３】　ネットワーク接続装置１００ｃの記録部１０７ｃに記録されるエントリの例である。
【図２４】　ネットワーク接続装置２００ｃの記録部１０７ｃに記録されるエントリの例である。
【図２５】　ＡＲＰリプライパケットフォーマットの一例を示す図である。
【図２６】　本発明にかかるネットワーク接続装置の実施の形態５の構成を示す図である。
【図２７】　実施の形態５のネットワーク接続装置を用いたネットワークシステムの一例を示す図である。
【図２８】　従来のシステムの構成を示す図である。
【図２９】　ＶＲＲＰを用いたネットワークシステムの構成を示す図である。
【図３０】　ＶＲＲＰで用いられるＡＲＰリプライパケットフォーマットの概略を示す図である。

【符号の説明】
１００，１００ａ，１００ｂ，１００ｃ，１００ｄ，２００，２００ａ，２００ｂ，２００ｃ，２００ｄ　ネットワーク接続装置、１０１，１０１ａ，１０１ｃ　状態確認部、１０２　接続装置情報収集部、１０３，１０３ａ，１０３ｃ，１０３ｄ　接続装置情報交換部、１０４，１０４ｃ　パケット送信部、１０５中継部、１０６　比較部、１０７，１０７ｂ，１０７ｃ　記録部、１０８　ＡＲＰテーブル、１７３，１７３ｄ　パケット生成部、１７４，１７４ａ，１７４ｃ，１７４ｄ　サブネット選択部、１７５ａ，１７５ｃ　転送パケット生成部、２１０，２１０ｂ　バックボーンネットワーク、２１１，２１１ｂ　通信パス、２２１，２２２，２２７　端末装置、２２３，２２４　ＡＲＰテーブル、２３０，２３０ｂ，２４０ｂ，２５０ｂ　サブネット、２３１，２３２，２３３，２３４スイッチングハブ、２８１，２８２，２８３，２８４，２８５，２８６，２８７，２８８，２８９，２９１，２９１ｂ，２９２，２９２ｂ，２９３，２９３ｂポート、４４１　リクエスト送信部、４４２　受信部、４４３　学習部、５０１ｂ　ＡＲＰパケット中継部、５０４　サブネット分断箇所、５１８　ＡＲＰパケット受信部、５１９　検索部、５２０　リクエスト転送部、５２１　バックボーンパケット受信部、５２２　リプライパケット変換部、５２３　リプライパケット送信部、５２４　サブネット選択部、５２５　リクエストパケット変換部、５２６　リクエストパケット送信部、５２７　リプライ転送部、６４１ｃ　回復パケット生成部。

【図１】

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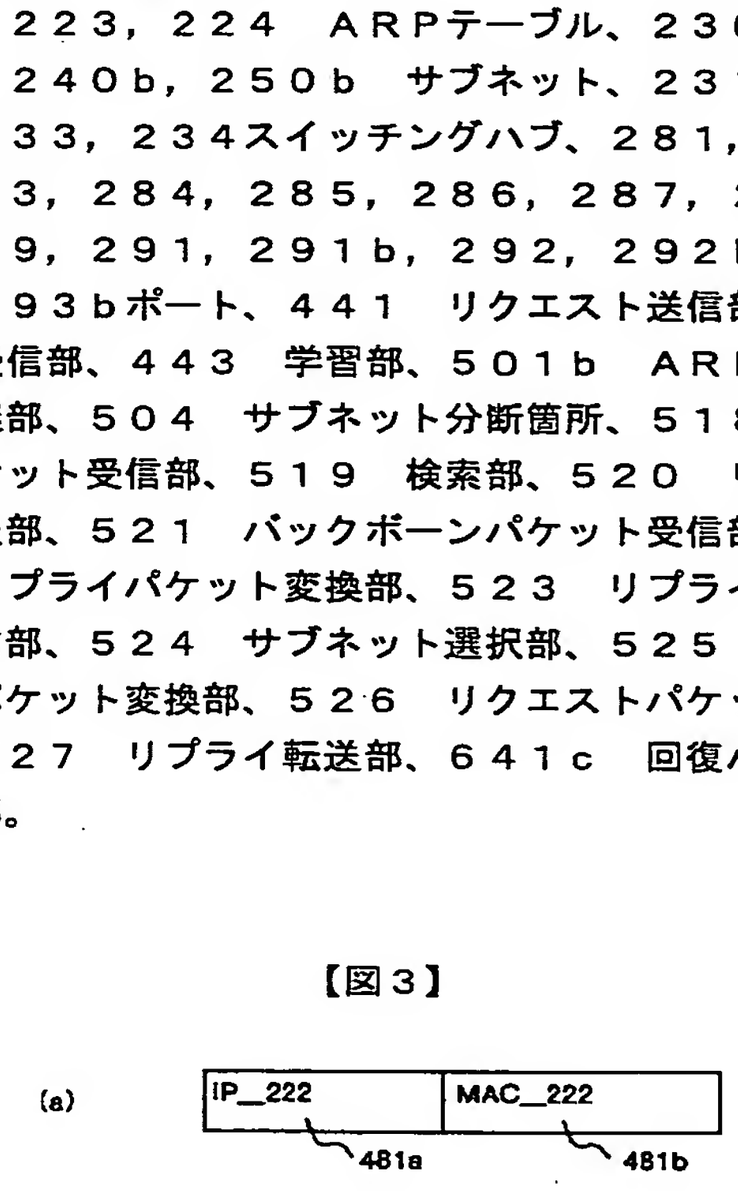


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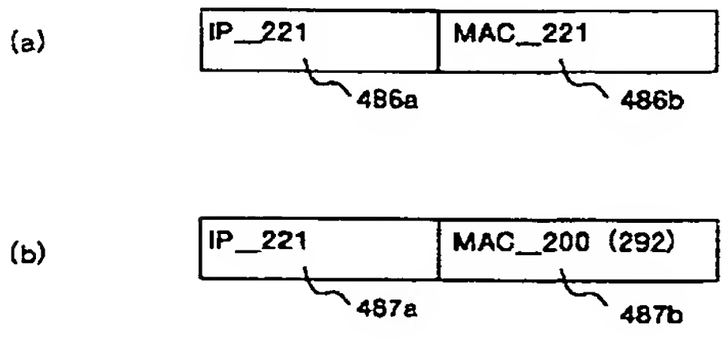

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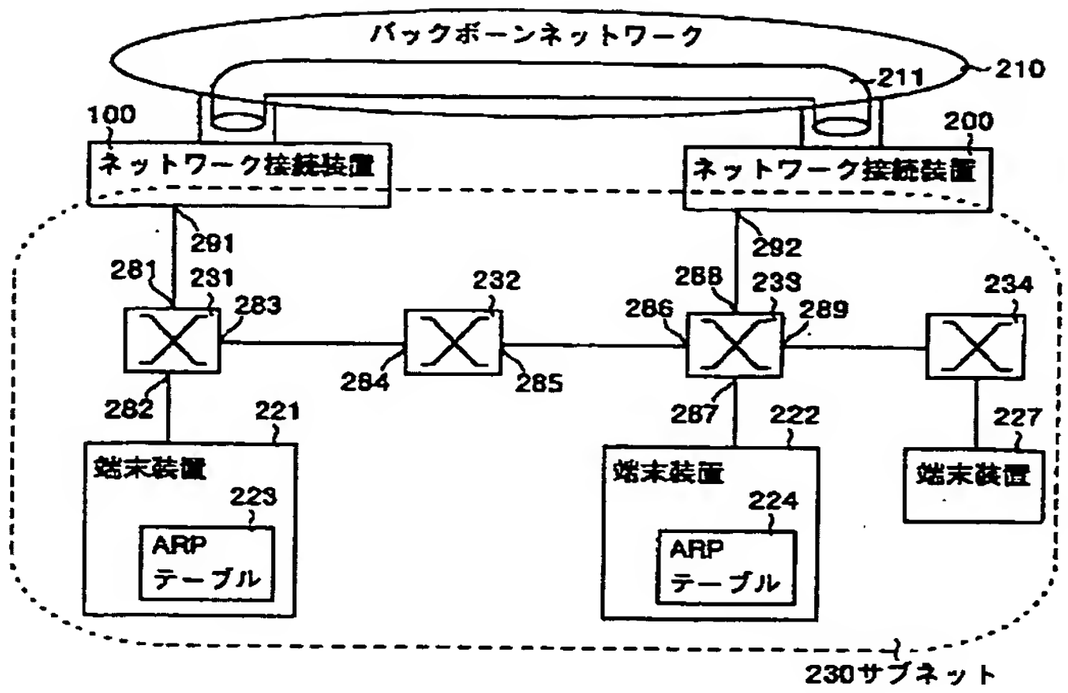


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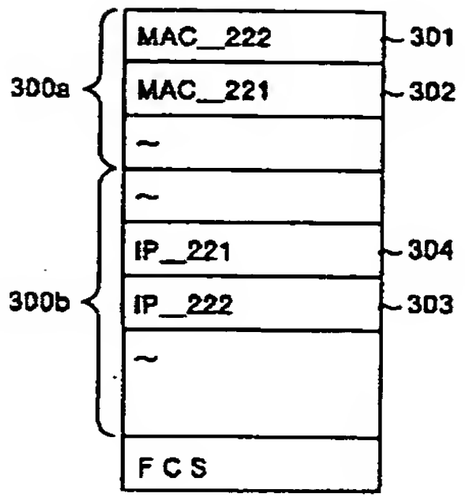


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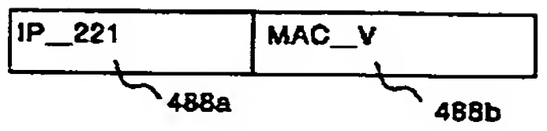


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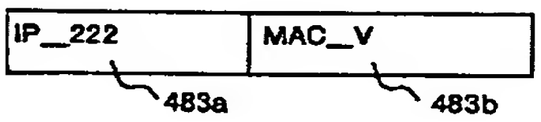


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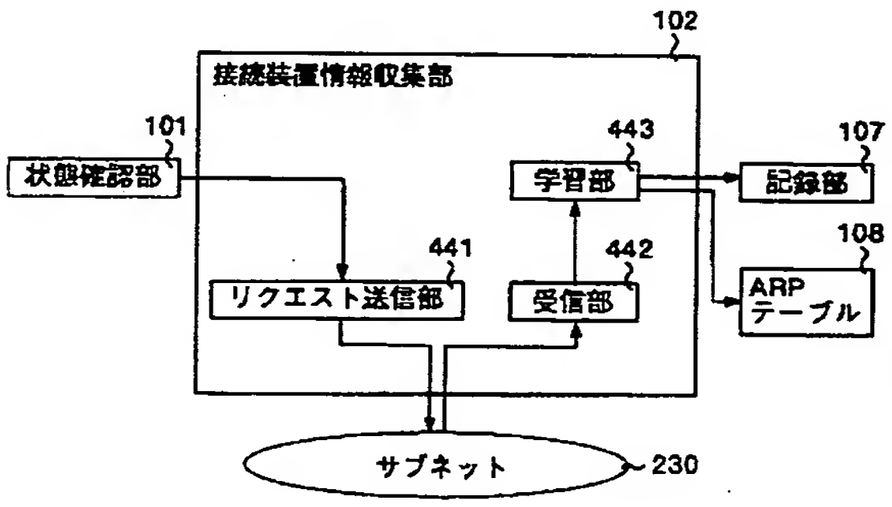


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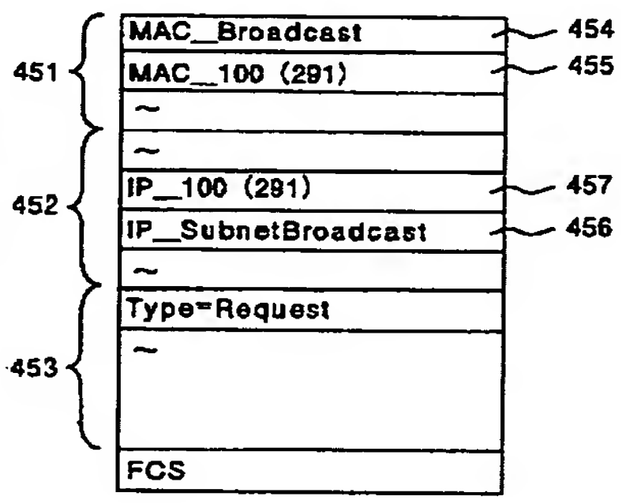


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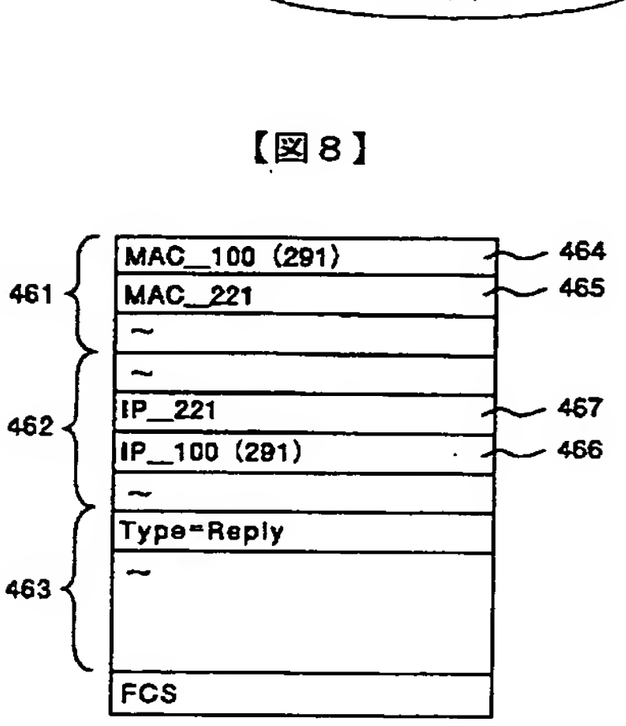


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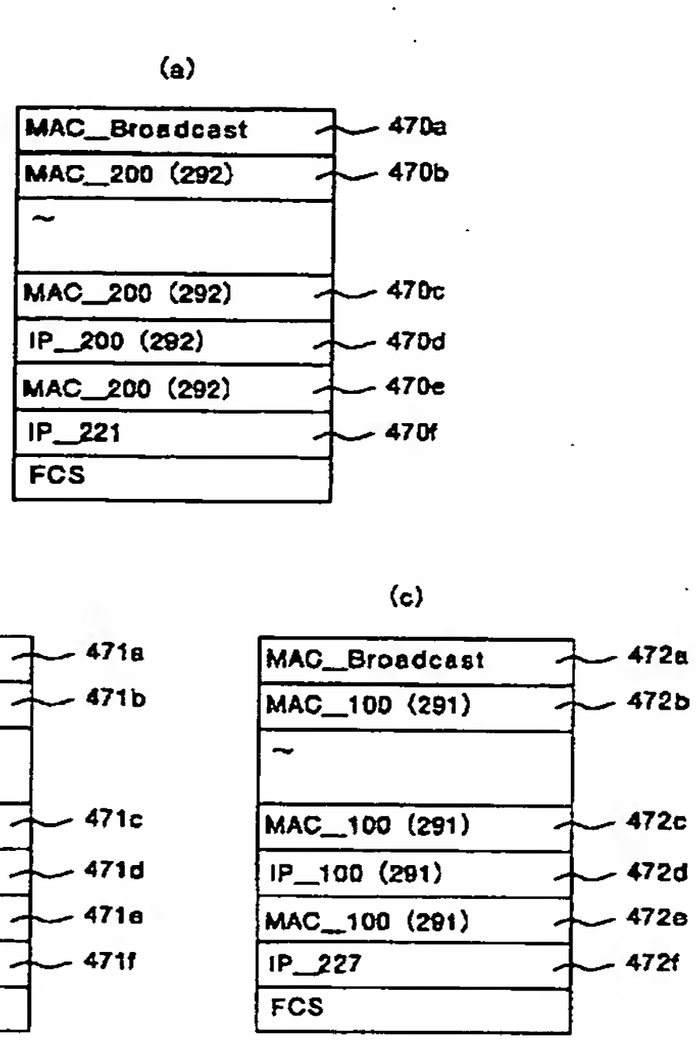


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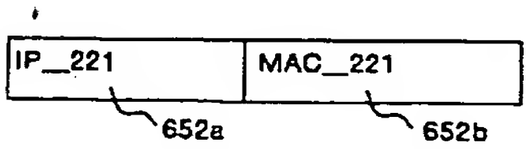

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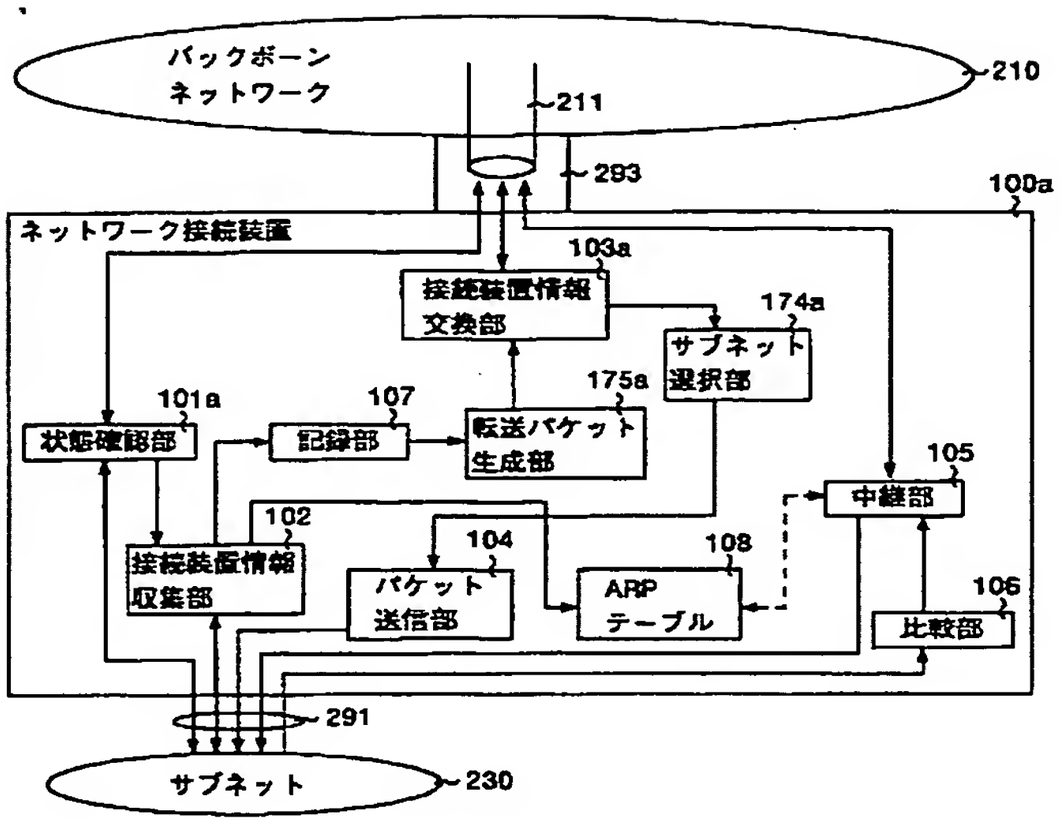
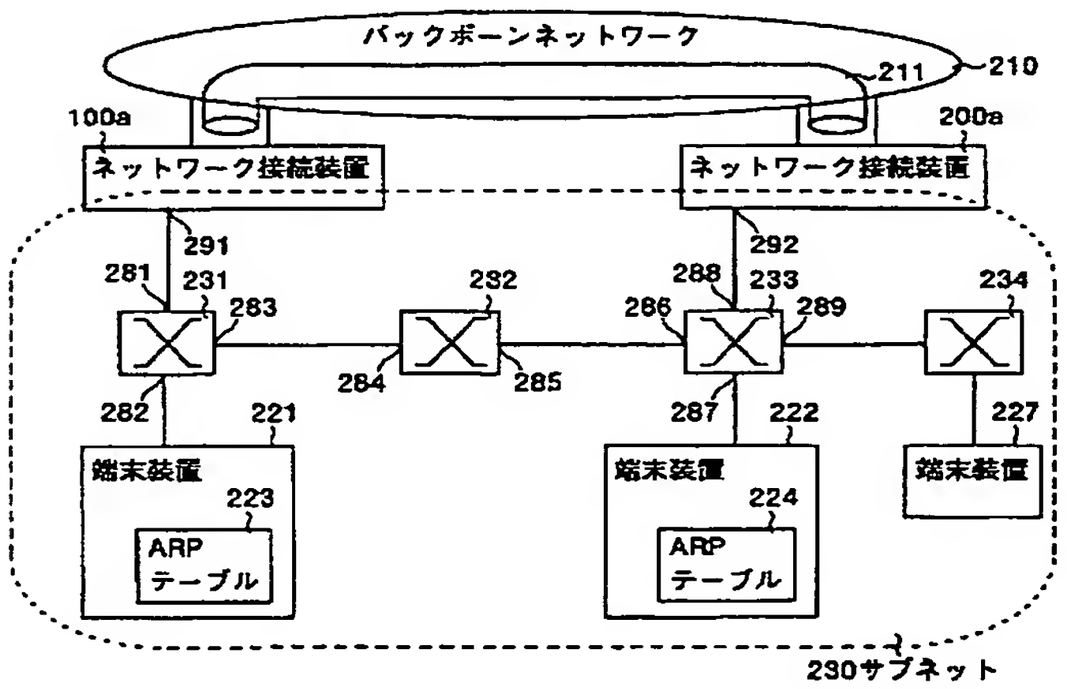



【図１１】

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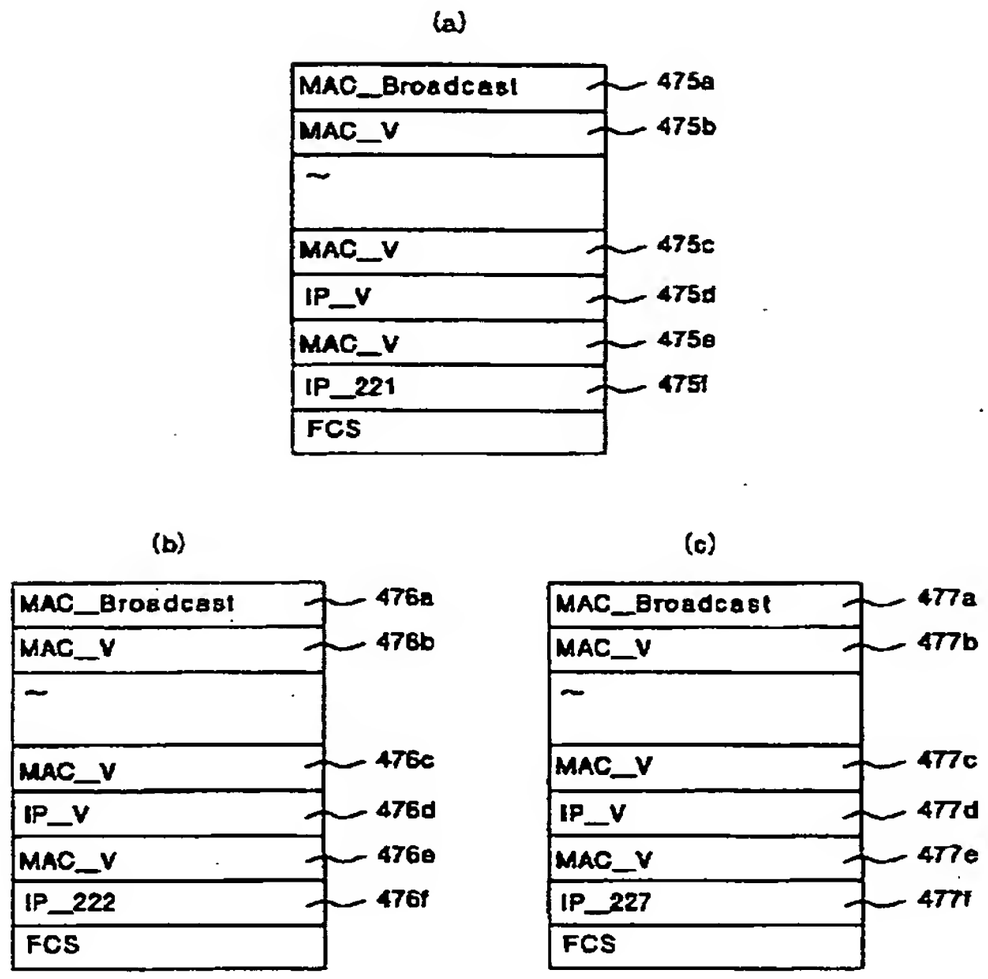


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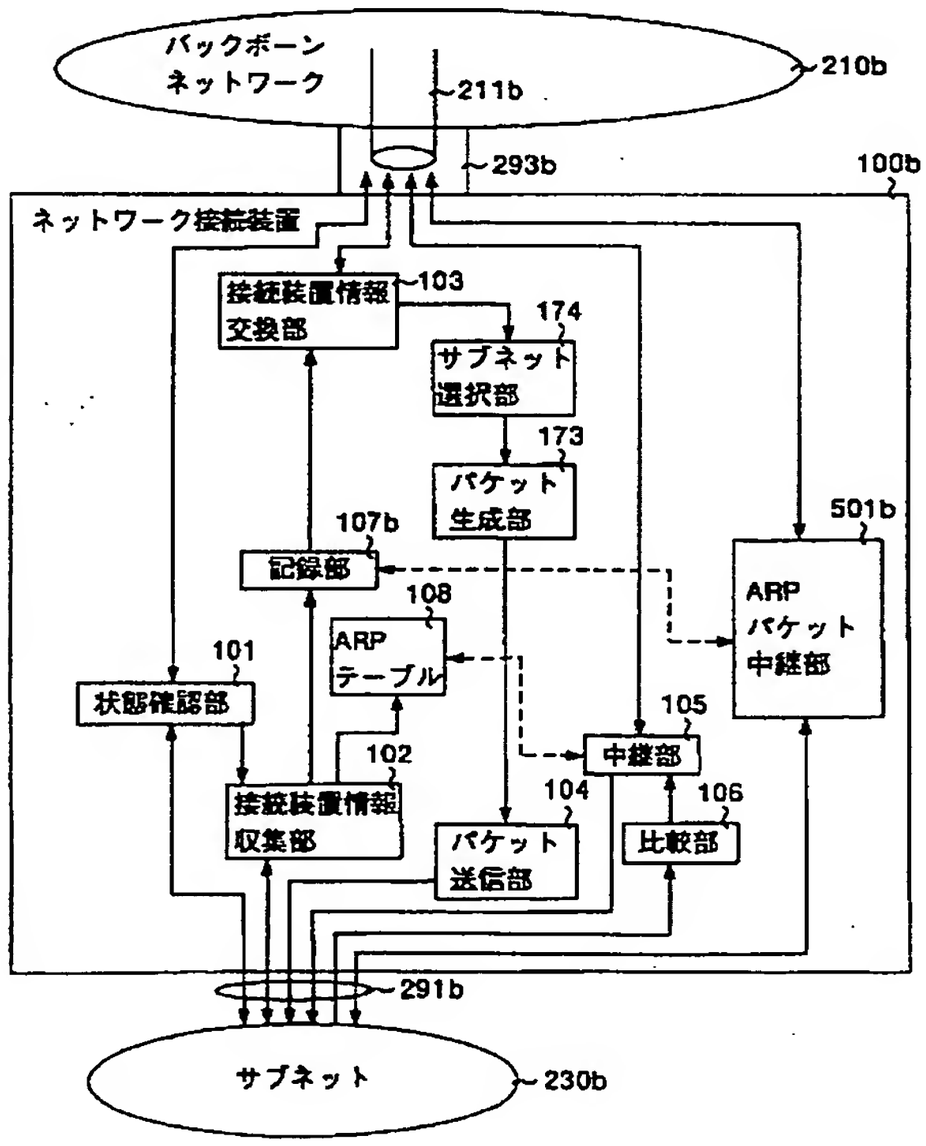


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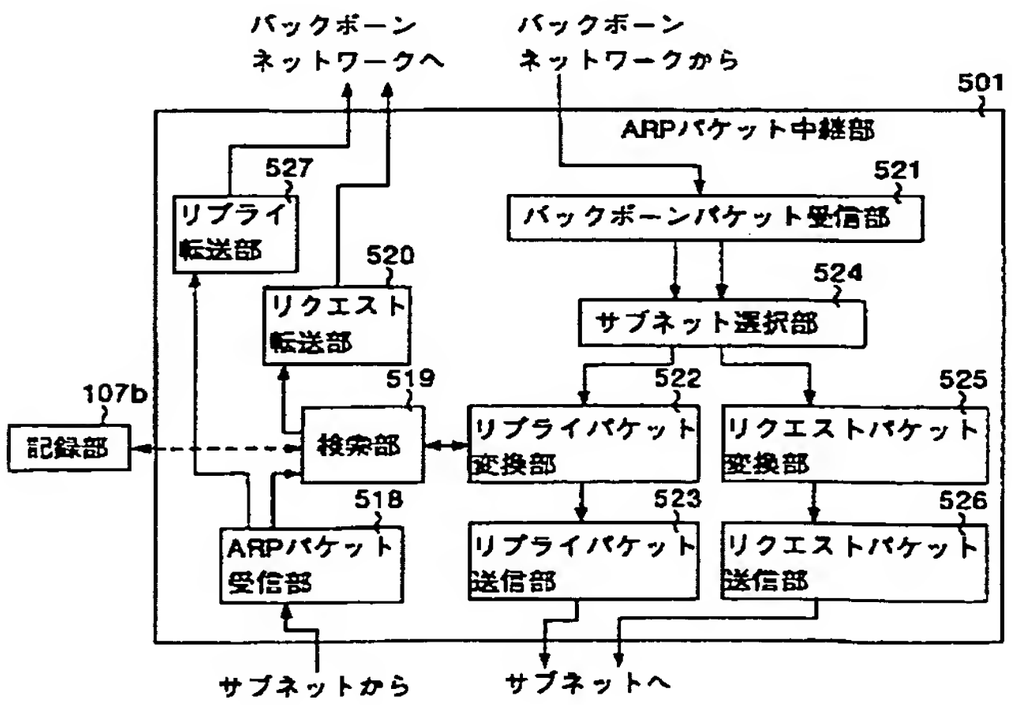


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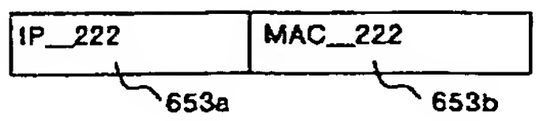

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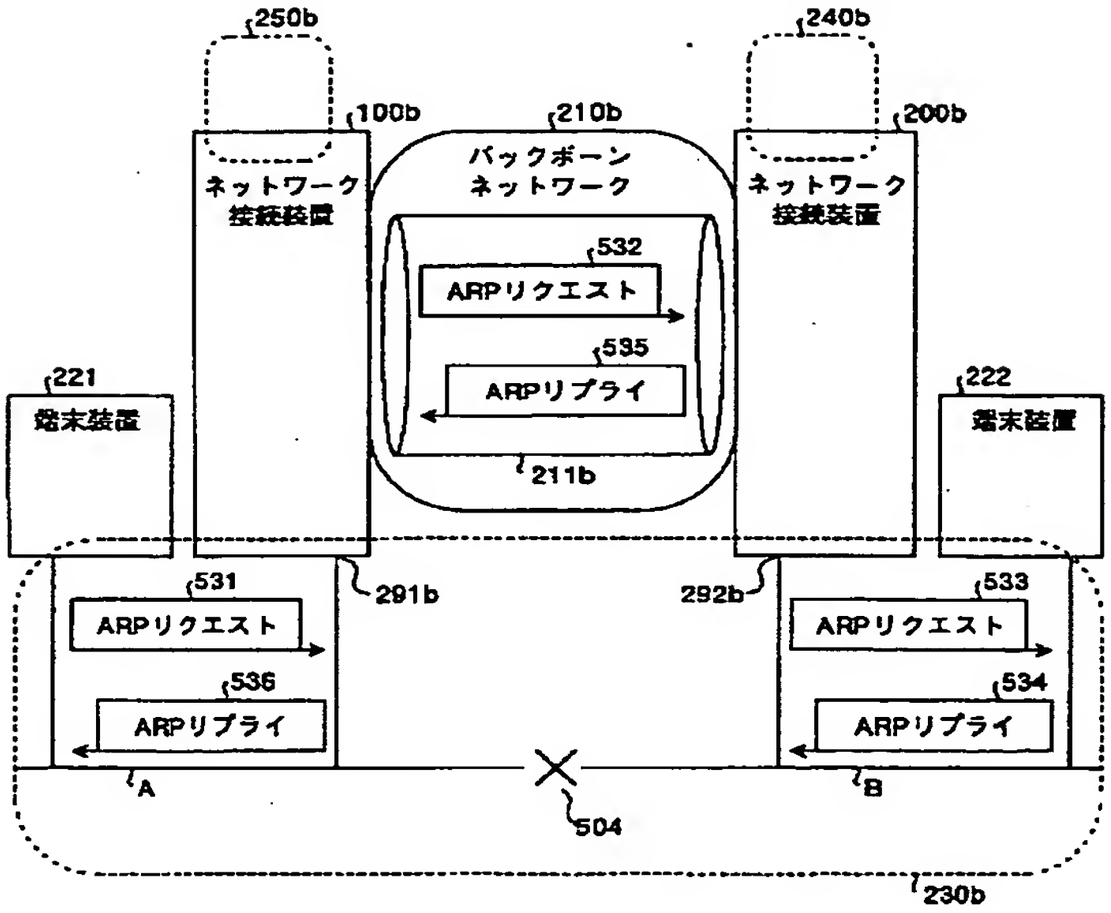


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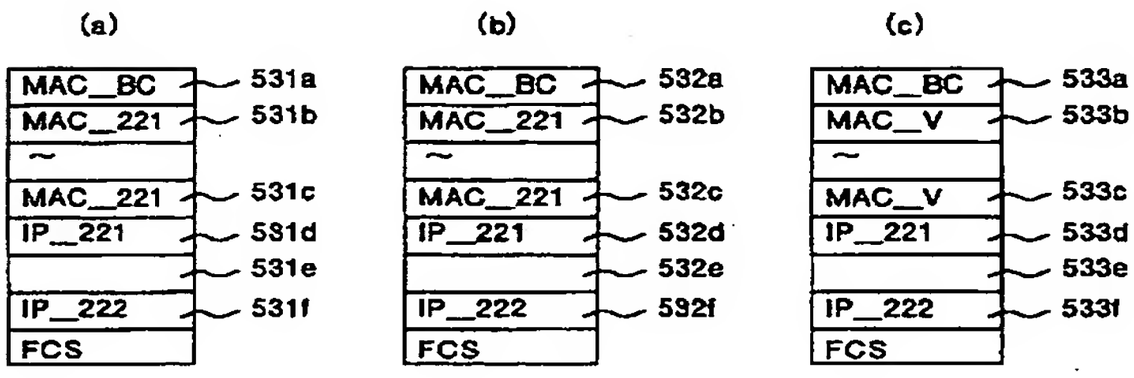


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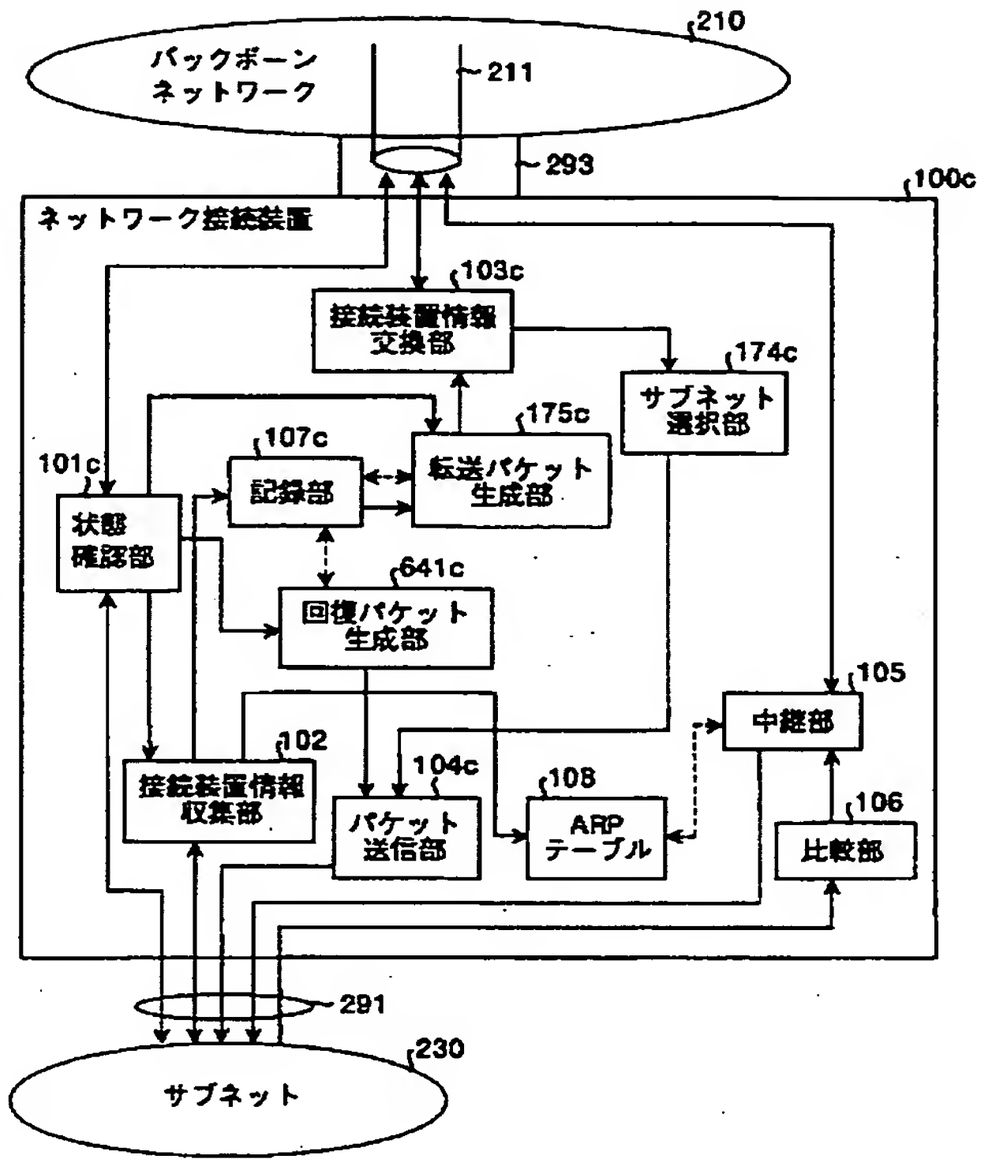


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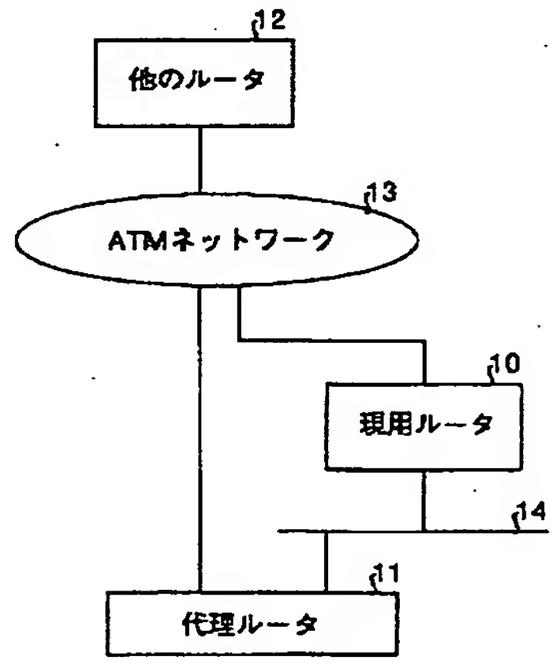


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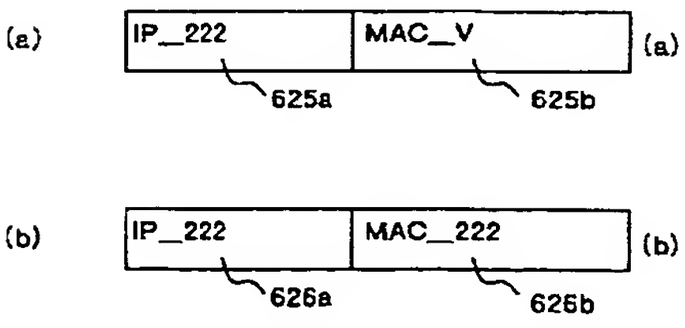


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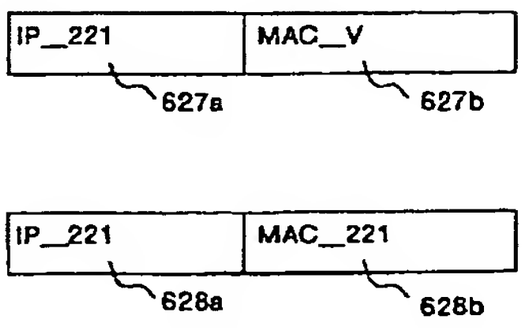

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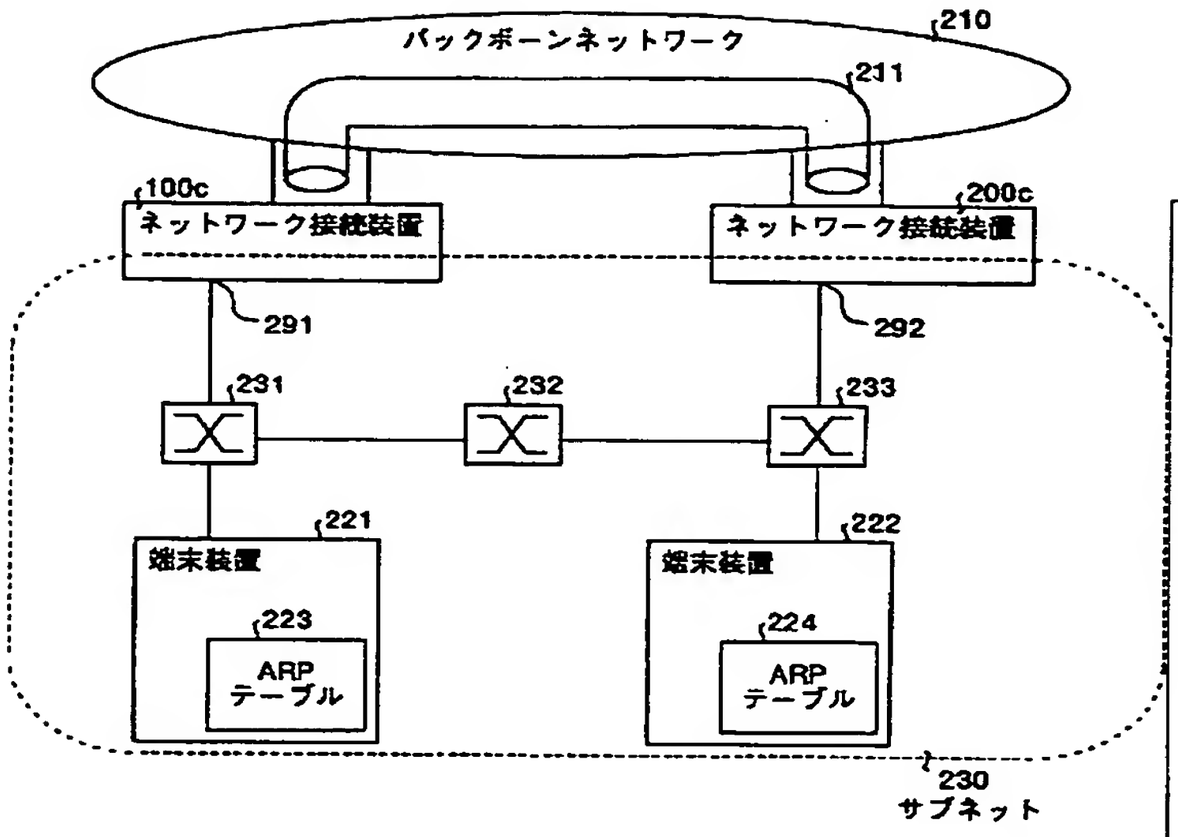


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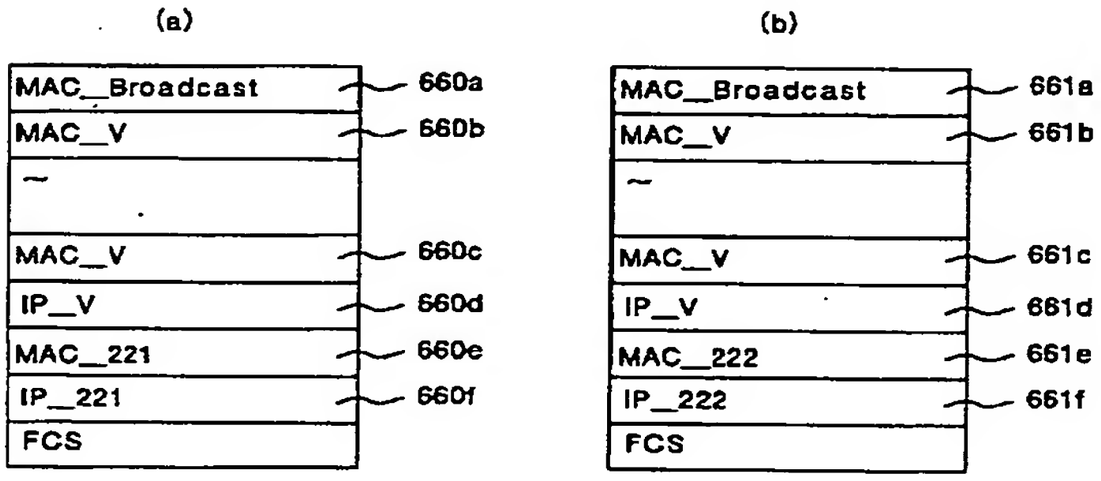


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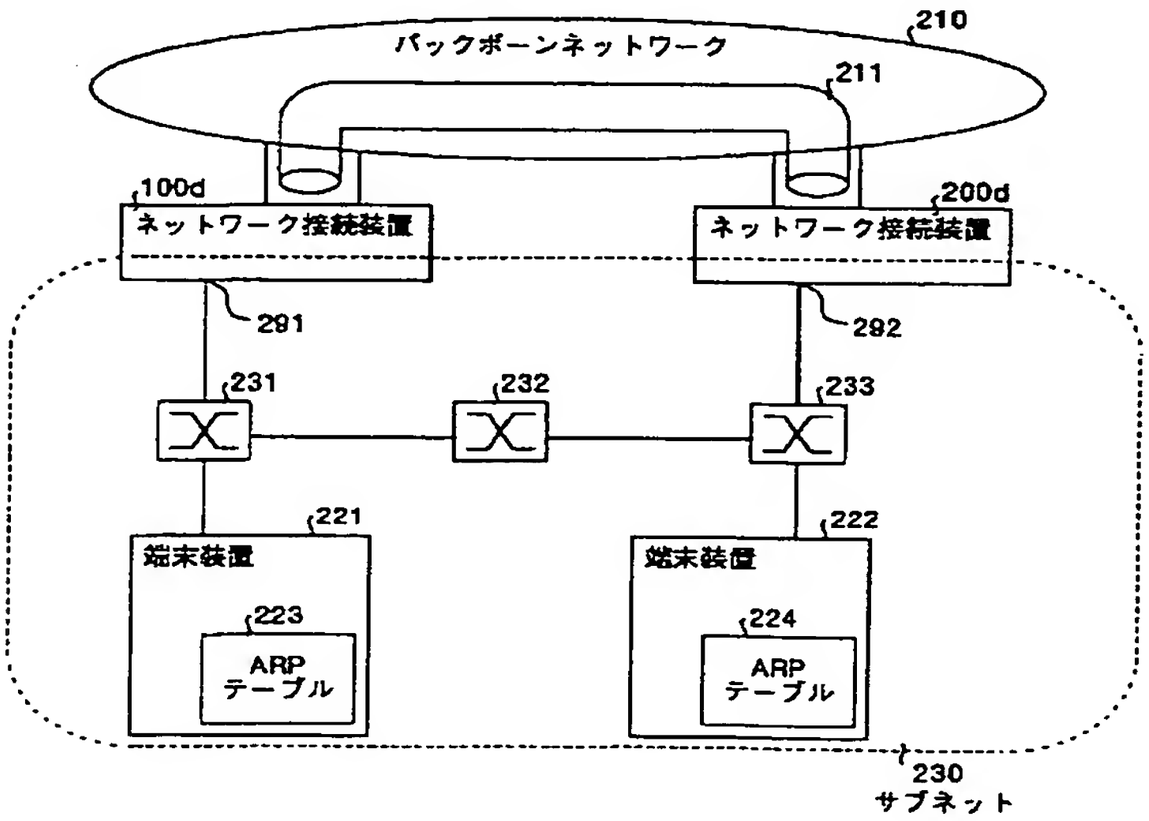


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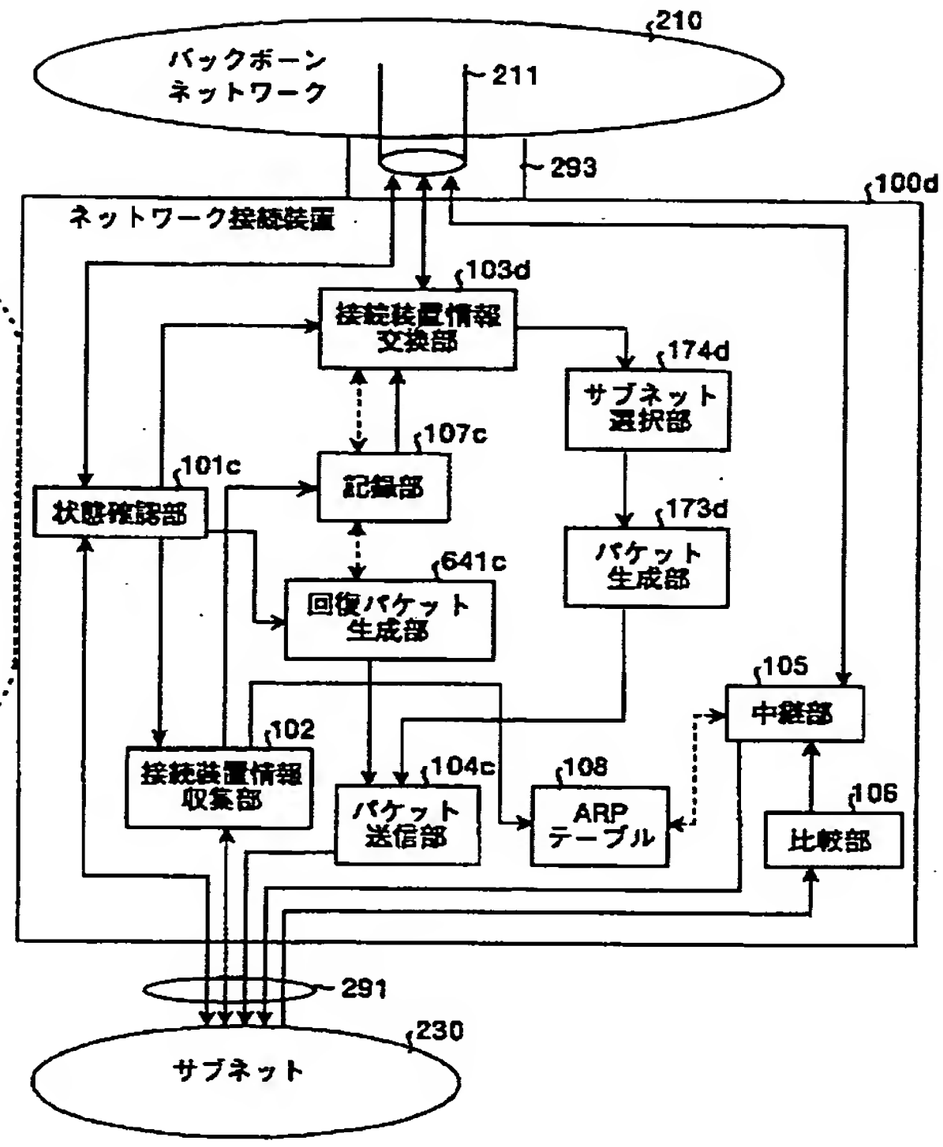


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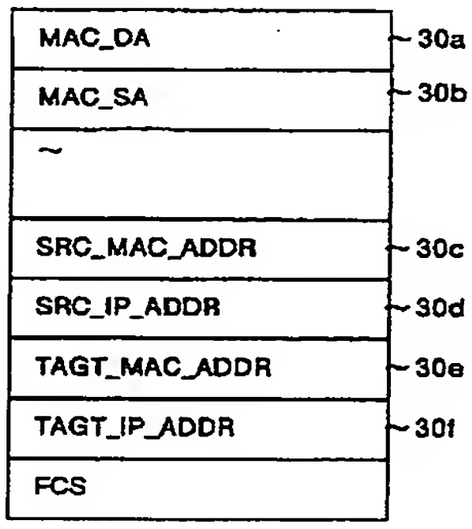

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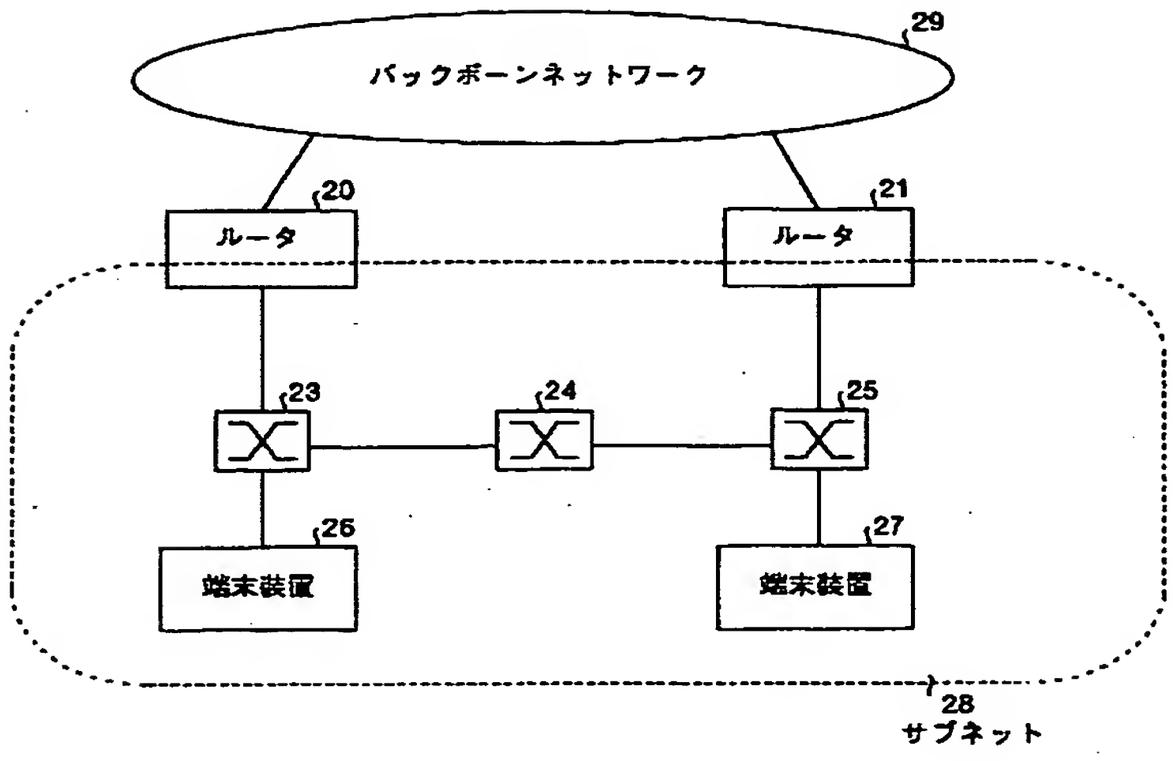


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